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REPORT

ON THE

CONSTRUCTION OF A MILITARY ROAD

FROM

FORT WALLA-WALLA TO FORT BENTON.

By Capt. JOHN MULLAN, U. S. A.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1863.

37th Congress, } SENATE. { Ex. Doc.
3d Session. } { No. 43.

LETTER

OF

THE SECRETARY OF WAR,

TRANSMITTING,

In answer to a resolution of the Senate of the 6th instant, the report and maps of Captain John Mullan, United States army, of his operations while engaged in the construction of a military road from Fort Walla-Walla, on the Columbia river, to Fort Benton, on the Missouri river.

February 19, 1863.—Read, ordered to lie on the table, and be printed.

War Department,
Washington City, February 19, 1863.

Sir: In compliance with the resolution of the Senate of the 6th instant, I have the honor to transmit herewith the report and maps of Captain John Mullan, United States army, of his operations while engaged in the construction of the military road from Fort Walla-Walla, on the Columbia river, to Fort Benton, on the Missouri river.

I am, sir, very respectfully, your obedient servant,
EDWIN M. STANTON, *Secretary of War.*

Hon. Solomon Foote,
President pro tempore of the Senate.

Office Military Road Expedition,
Topographical Bureau, Washington, D. C., February 18, 1863.

Sir: I have the honor herewith to transmit to your bureau the final report of my operations while in charge of the military road from Fort Walla-Walla to Fort Benton, with eight illustrations. Accompanying the report are one general map and three detailed maps, all compiled from our original field-notes. All these are worthy of publication, and particularly the general map.

I am, sir, truly, your obedient servant,
JOHN MULLAN,
Captain 2d Artillery, in charge of Military Road.

Major J. C. Woodruff,
United States Topographical Engineers,
Chief of Topographical Bureau, Washington, D. C.

OFFICE MILITARY ROAD EXPEDITION,
Topographical Bureau, Washington, D. C., February 14, 1863.

SIR: I have the honor to submit to the War Department the following final report of my labors and operations in connexion with the exploration, location, and construction of the military road from Fort Walla-Walla, on the Columbia, to Fort Benton, on the Missouri river, comprising a period from March, 1858, to September, 1862. At short intervals, while engaged in the field, sub-reports in full detail were submitted to the bureau, and your department was kept advised of the prosecution and progress of the plan of the work; also the causes that led to the location of each special section of the line as it was handled en route. The material, however, contained in these sub-reports, though important to be known to the bureau at the time of the location and construction of the road, has lost much of its special value since the road has become completed. In making to you, therefore, this my final report, I have deemed it due to the character of our work and to the labors of those who have followed and assisted it to a successful completion through so long a period, to give a brief outline memoir of the causes that led to its first exploration and location, the special difficulties under which this construction was had, and the ulterior views and ends sought to be accomplished in part by the completion of the work.

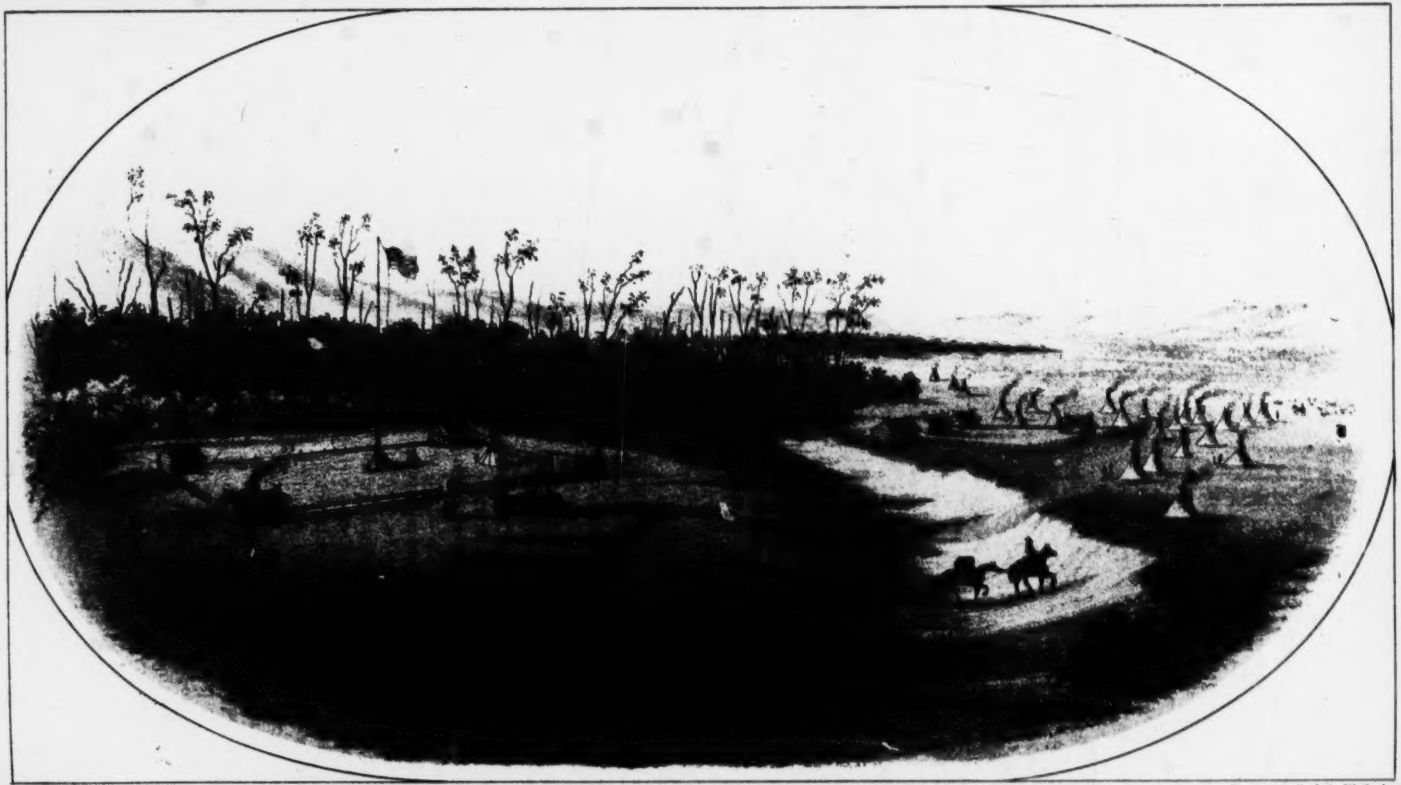
The necessity felt by the government for a more thorough and satisfactory knowledge in detail of the geographical and topographical character of the country that lay between the Mississippi river and the Pacific ocean, looking especially towards the location and construction of a Pacific railroad, called into the field, in the spring of 1853, under authority from Congress, several corps of engineers and explorers, whose mission it was to supply this desired information within certain limits of time and means.

To one of the fields of exploration laid out by the department was assigned the Hon. Isaac I. Stevens as chief, to whom, at the same time, I was assigned as one of his several assistants, and in that capacity accompanied his expedition across the country from Minnesota to the Pacific.

The problem of a railroad connexion from St. Paul across the prairies to the eastern water-shed of the Rocky Mountains, in latitude 46 and 47 degrees, was one of easy solution, and the country was therefore accurately and rapidly explored; but the late autumn of 1853 found our labors of exploration truly only begun; for we now entered the more difficult section of the Bitter Root range of the Rocky Mountains, where the lateness of the season, the difficulty of the country, the importance of our mission, the scarcity of our supplies, the meagerness of the information we then possessed, and the necessity felt for a more detailed and thorough exploration of the Rocky Mountain section, since proved to be the key of the work, together with other equally cogent reasons existing at the time, all conspired to influence Governor Stevens to leave in the mountains a small party for the winter of 1853, for further explorations, and thus supply that information which a lack of time did not allow him to collect at an earlier period.

To the command of this winter party I was assigned in October, 1853, and selecting in the genial range of the Bitter Root a suitable location, and there erecting comfortable, though rude, log huts for my men, I made it a centre from which to explore the mountain region which included the sections whence flow the sources of the Columbia and Missouri rivers in a network of babbling brooks.

The margin of authority left me by Governor Stevens was broad and liberal, and the field to be explored was only commensurate with the importance of the work that called us to its exploration. The most essential thing at that time was a general reconnaissance and exploration of the country before the question of location and construction of a railroad line could be at all profitably or



Drawn by C. Sohon.

CANTONMENT STEVENS._CAPT. MULLAN'S WINTER QUARTERS 1853-4.

Bowen & Co lith Philada.

properly considered; and up to that date the only basis that formed our knowledge and understanding of the country was the map left us by Lewis and Clark in 1805, together with such addenda as the more intelligent of the employees of the Hudson's Bay Company were able to give us, or the scraps of information which the chance traveller or sojourner in the country felt disposed to offer.

That the field of labor assigned to Governor Stevens, owing to the meagre information possessed at that date, was the most difficult to be explored, I believe few will doubt; and that he filled it with an ability and energy, so characteristic of the man, I can personally vouch. His labors have left to the country a very correct outline of the geography of the Rocky Mountain sections, examined by his parties, which needs hereafter only the minutiæ which the more detailed surveys and time will supply, to complete our knowledge of the entire north Pacific region. In connexion with the proper location and construction of a railroad, one of the most essential aids in advance was a good wagon-road line; and looking at the necessity of transporting supplies and material over a long line from eastern to western depots, which the Pacific railroad on all lines will necessarily involve, this last became a subject of primary importance, and reduced the spirit of my own work almost to exploring the country for practicable wagon-road locations, which, in time, should lend themselves as aids to the construction of our railroad lines. The attention of Stevens was especially given to this matter at an early date of our explorations, and in his instructions to me was dwelt upon with more than ordinary emphasis and stress; and hence my mission in the winter of 1853 was to solve the problem of a proper connexion, through a practicable mountain pass, of the plains of the Missouri with the plains of the Columbia, between the 45th and 48th degrees of north latitude, for either wagon road or railroad lines, and to make my reports thereon; and, therefore, my present connexion with the Fort Walla-Walla and Fort Benton military road dates therefrom.

In making our explorations in 1853 we had used a wagon train from St. Paul's, Minnesota, to Fort Benton on the upper Missouri river, at which last point it was deemed judicious to abandon it, and complete our work with the use of pack trains; and the character of the country in advance was such that this afterwards proved not only a wise but necessary step.

The eastern or the western plains, as a general thing, interpose but few physical obstacles to the location of a practical wagon road; but the mountain sections form special problems for solution, which are not always so easily handled. The only continuous overland wagon-road line, at that date, travelled to the Pacific was by the South Pass, where the difficulties were so few that it was then, and is now, probably, the great highway across the continent. But the region of the sources of the upper Columbia and Missouri rivers, the great arteries of our country, was an area that the geographer had already pointed out as a fruitful field for development, and which our later explorations showed to be worthy of a more detailed examination than it had received up to the time it became our more especial field to study.

The question of the navigation by steam of the upper Columbia and Missouri rivers was, at that date, in the infancy of its discussion, but was deemed of such importance that its practical solution was looked upon by the friends and advocates of the railroad line as the *sine qua non* to the full and speedy settlement of the country between them, as well as the all-important aids in the construction of a Pacific railroad *via* a northern route.

The limited commerce and travel along the narrow margin of the Columbia and its principal tributary, the Willamette, at that date, gave employment to one or more smaller sized steam-craft, that were ample to do the business of those who looked towards the Dalles as the head of steam navigation on the Columbia, or to Oregon City, that of the Willamette; and on the eastern water-shed of the Rocky mountains a solitary steamer, engaged in the fur trade, that made its annual trips from St. Louis till it crept along the waters of the Missouri to a region where the red man alone walked, though a pioneer to the long line of steamers that must follow in the wake of its trade and development, constituted the only attempt made to test the further navigation of this noble river towards its sources in the Rocky Mountains. The necessity, therefore, of testing by steam the further practicability of each of these rivers entered as a great, indeed as an essential element in an overland connexion between the two, in order to attain the minimum land transit; and hence to solve the special problem of connecting, by a continuous practicable wagon-road line, the head of steam navigation between the two, be those heads where they may, formed the spirit of the end of my work, to which all things else were subordinate means. The field examined by my party, in 1853 and 1854, extended from the valley of the Kootenay river on the north to Fort Hall on the Snake river on the south, between which extreme limits the western link in the chain of connexion with lines from the upper Mississippi must lie.

During the interval, through hunters and trappers and those familiar with the country from a long residence in the mountains, we were enabled to glean much information that formed the basis for our own more detailed examination. Pack trains constituted our own, as it did then the only means of transportation of all other persons when travelling in the country, and as to move from point to point by the aid of wagons did not enter into the necessities of the persons then resident in the country, so it did not enter into the subject either of their thoughts or discussions; and hence to ascertain from them, *à priori*, where wagon trains could or could not go, was not a matter easily ascertained; but every pass in the range had to be examined with this especial object in view. The result of our earlier explorations showed the Bitter Root range, between 45° and 48°, to be a marked geographical centre, and the capabilities that developed themselves under our own eyes confirmed our first views of the importance of its having a direct connexion with the main valleys of the rivers on its either slope.

During the winter of 1853 many were the conversations held with whomsoever could give us information of the geography of the country; and through a half-breed named Gabriel Prudhomme, who had been a voyageur and travelling companion of the earlier Jesuit fathers in their pilgrimage through the Rocky Mountains, I was enabled to glean such data concerning a line from the Bitter Root valley to Fort Benton that I was induced, in the spring of 1854, to explore it with a small party. Upon examination it proved to be not only feasible in itself, but, with a small amount of labor, could be rendered a very proper connexion with the line we had followed from St. Paul's, Minnesota.

We left the Bitter Root valley on the 1st March, crossed the Rocky mountains on the 10th, reached Fort Benton on the 14th, and on the 17th of the same month, having fitted up a wagon train, we recrossed the range, and reached our original starting point on the 31st.

This gave a test of practicability that could not well be gainsaid; and, deeming the matter of so much importance, I at once despatched my expressman, Pearson, to Governor Stevens, with the result of the exploration. This discovery gave fresh hopes to the governor and the friends of the road, all of whom were anxious to open the section by an emigrant line of travel.

This resulted, at a later period, in an appropriation of $30,000, the first of a series to open a wagon road from Fort Benton to Fort Walla-Walla. Though the eastern connexion from the Bitter Root valley was attained by this expedition to Fort Benton, yet the region for the proper location of the line westward to the Columbia had not been thoroughly examined.

The difficulties and disasters arising from snow and other obstacles that attended the trip of Mr. W. W. Finkham, one of our civil engineers, *via* the southern Nez Percés trail in 1853, were such as to preclude the possibility of this line being chosen for a field of further examination, much less for a wagon-road location. The only other lines left us were Clarke's Fork, St. Regis Borgia, Cœur d'Aléne valley, and the Lo-Lo Pass. A just estimate of the comparative advantages possessed by these several lines could only be arrived at by an especial examination of each and all of them by the same person.

I learned, through an old Iroquois Indian called Æneas, now resident in the Bitter Root valley, whose wanderings amid the mountains had often thrown him with parties travelling with wagons at the southward, thereby rendering him capable of judging of the requisites for a wagon road, that a line could be had through a gorge-like pass in the Cœur d'Aléne mountains. Our later explorations proved this to be Sohon's Pass. Placing a partial confidence in his judgment, I sent Mr. Thomas Adams, one of our topographers, with Æneas as a guide, as early as March, 1854, to make an especial examination of this point. The snow prevented Mr. Adams from prosecuting his undertaking further than the Kulkullow creek, and he returned, leaving the examination to be made at a later period. In May, 1854, availing myself of a visit from reverend Father Hoecken, S. J., then a missionary with the Lower Pend d'Oreilles Indians, I determined to examine Clarke's Fork valley in person, and starting with a pack train explored the country as far as the Pend d'Oreille lake, where, finding the streams much swollen, with the lake trail under water, and no trails above through the forest, I was compelled to abandon my animals at the east end of the lake and continue my further examination to the Lower Pend d'Oreille mission by means of canoes.

From what I saw of Clarke's Fork and the neighboring country, I concluded that a wagon route could be easily and economically constructed from Hell's Gate Ronde to the east end of the lake; the Bad Rock, Cabinet mountain and Pack river would form, it is true, three difficult problems, but could be solved by time and means; but the chief difficulties would be found in the section around the lake. This lake during the freshet has a rise of from ten to fifteen feet, completely covering the low water trails, thus forcing a location above high water mark and along the slopes of the difficult rocky spurs jutting upon its northern rim; from which I concluded a construction at this point could only be made at a heavy outlay; the Indians, also, gave me to understand that the country back was so difficult and impracticable that during the period of high water all travel was suspended.

I have always exceedingly regretted that it was my fortune to examine this route at so unfavorable a period, for I have been convinced by later data that it possessed an importance, both as regards climate and railroad facilities, enjoyed by no other line in the Rocky Mountains between latitudes 43° and 49°; these facilities I will refer to more in detail in a future portion of my report.

I now determined to take in my return route to the Bitter Root valley the pass known to Æneas, and with this view I started for Fort Colville to replenish my supplies, and from thence, *via* the Spokane, I went to the Cœur d'Aléne mission, where, meeting the reverend Fathers Josét, Ravalli, and Gazzoli, S. J., I laid before them my desires and requested their co-operation. I deem it but simple justice to these reverend gentlemen to here state that, although we often differed as to the minor details of administration and government of the Indians, yet, looking towards the ultimate ends and objects of my mission, I ever found them my staunchest and most reliable friends.

Finding the Fathers possessed of but little geograpical information that suited my purpose and the Indians absent at the camass grounds to the southwest, my only means left was to make an especial visit to their camps and interrogate them. The reverend Father Josét volunteered to accompany me, and on reaching the Indians I found them much averse to giving me any information regarding the country, and on one pretext or another, declined to serve me in any capacity. The Fathers had told me of a route they heard of from the Indians which, crossing the Bitter Root mountains near the sources of the Palouse, followed a generally easy and practicable country until it reached to main Bitter Root valley near the Lo-Lo Fork. Did such a route exist it lay in an admirable connexion with our line recently examined towards Fort Benton, and hence I became exceedingly anxious to reconnoitre it; but circumstances were against us and no examination was ever made. Whether such a route does exist I have never been able to discover, after endeavoring to do so for a period of seven years; my opinion is that it does not; certainly no such line is now travelled. After much solicitation I procured the services of Bassile, a Cœur d'Aléne Indian, to accompany me in the capacity of a guide through the Cœur d'Aléne and St. Regis Borgia valleys. We made this examination in June. As the rivers were still swollen we were compelled to take to the mountain slopes, down ravines, and over much fallen timber. I was much pleased with the general aspect of these valleys, watered as they are by rivers flowing from the same source in opposite and parallel directions. That much work was required to lay and construct a first-class road was self-evident; but its direction and short distances, and the connexion made with the Spokane on the one side and with the Bitter Root on the other, were recommendations in its favor that caused it to occupy, in my judgment, a higher place than a line by the Clark's Fork.

From this, therefore, dates the period and reasons why the Cœur d'Aléne Pass route was looked forward to, both by Governor Stevens and myself, for the ultimate location of our route; and as the War Department possessed no other knowledge of the country it was natural that they should do as they did, viz: indorse our joint views then given from a consideration of all the data that went to form our conclusion. But I am free and frank to admit that there was one element which we had ignored, and this was the one of climate.

All of our explorations up to the date of our leaving the field in 1854 had been confined to the spring, summer, and autumn months, and it is a self-evident proposition to those familiar with the winter character of the Rocky Mountains, that it is impossible for a man to express a winter view from a summer stand-point.

This was the error that we made, and a very natural one from the mode of reasoning adopted by us and many others, as fallacious as it is paradoxical. We reasoned thus: that the Cœur d'Aléne route lying to the south of the Clark's Fork by fifty or sixty miles, and the difference of altitude being small, that all questions of climate were supposed to be in favor of the more southern line; and hence, supposing the element of climate in both instances to be equal, or, if there was a difference, that this difference was in favor of the more southern route, which general analogy would grant us, that, as distance, direction, and connexion were all in favor of the Cœur d'Aléne Pass, our location must be *via* this route and no other. But our later winter examinations have developed this marked and most important fact, that as you go north in this Rocky Mountain region within certain limits, that the climate is milder, the snow less deep, that horses can travel all winter, and the general characteristics of winter are all less severe; and that there does exist a zone or atmospheric river of heat in that region I am free to vouch and can substantiate by facts, and which I desire to treat upon further in my report.

But to come to the bearing of this most important meteorological fact upon our wagon-road location, I would state that had I known in 1854 what I did not learn until 1859, I should have recommended that the section of the road from Antoine Plant's to the Hell's Gate should have followed, at any cost of construction it called for, the Clark's route instead of the section *via* the Cœur d'Aléne mission. But it was not until a later date, when we had made snow profiles by measuring its depth every ten miles during the winter months, and made a record of the readings of the thermometer on both sides, that we were enabled to form a just comparative judgment of each. I can only trust that the developments taking place so rapidly in that region will yet demand that the Clark's Fork route be opened, and our experience in this connexion be of service to other exploring parties who would desire to give a truthful description of this Rocky Mountain region both in winter and summer. This may be placed on record as a fact: that to describe properly and truthfully the winter character of these mountains, all data must be collected in the winter season itself, as all rules and analogies applicable to the climates of other portions of the country there apparently fail.

In September, 1854, my party having been ordered in from the field, I determined to proceed to the coast by a new route, and the only one then left unexplored, namely, *via* the Lo-Lo Fork Pass; not that I felt or believed it to be practicable for wagons, but more with a view to arm my judgment with such facts as would not leave a shadow of doubt behind which should cause us to err in the final conclusion in so important a matter. This route I found the most difficult of all examined. After eleven days severe struggle with climate and country we emerged into the more open region where "Oro Fino" now stands, glad to leave behind us so difficult a bed of mountains. After examining all these passes my judgment was finally decided in favor of the line, *via* the Cœur d'Aléne Pass, as a proper connexion for a road leading from the head of navigation on the Columbia to that on the Missouri, and the result was so reported to Governor Stevens, under whose direction I was then acting.

Completing my field labors for the winter of 1854, I left Puget Sound in January, 1855, with letters for the War Department from Governor Stevens, and resolutions passed by the legislature of the Territory of Washington, recommending my continuation in the same field of labors. I found the War Department, though favoring the project, averse to its continuance, at that time, giving as a reason that the appropriation was inadequate to the character of the work, unless carried on in connexion with some large military movement that would justify its expenditure; and as it was not deemed judicious to direct at that time any such movement, the appropriation for our road remained untouched in the vaults of the Treasury Department till a later day, and the measure itself was allowed to slumber until the spring of 1857, when it was again taken up in connexion with a movement of the 4th and 6th infantry. Again it was abandoned, in consequence of a doubt on the part of the War Department as to its feasibility, until the winter of the same year. At this time Governor Stevens was in Congress; he had ever been one of the warmest friends, and, in fact, the projector, in a great part, of the enterprise; he knew and felt its great importance, and invited the attention of the War Department to it, asking that the work be at least commenced. His reasons were so strong and valid that a favorable indorsement was given, and I was once more ordered to Washington to take charge of the work. During this interval the subject of overland communication had grown in importance, and from a subject of speculation and doubt had changed to one of every day reality. While the central section became the field for wagon-road operations under Colonel Lander, the overland mail carried weekly intelligence over thousands of miles of mountain and prairie by a more southern route. These facts gave the friends of a northern line a right to be heard in their modest applications to have a route opened through their own section. The character of the Mormon disturbances, occurring simultaneously, was such as to compel the government to look the subject of overland communication direct in the face. Here were foes, with Indian emissaries in every quarter, whose obedience to law the government had to enforce at the point of the bayonet, by an army so large that the question of supplying it was one of no small import.

Even in this connexion our line entered on the score of economy and safety as a new route of transportation. Mr. Russell, of the firm of Majors & Russell, came to learn my opinion as to the advisability of transporting supplies by steamboat up the Yellowstone to the mouth of its tributary the Big Horn, and thence wagon them by a short transit to Salt Lake. Though approving the boldness of his scheme, I could not desire to see it attempted when so great objects as supplying an army depended upon its success or failure, hence it was abandoned.

The subject of route and location having been frequently discussed with General Humphreys, who, from his connexion with the Pacific railroad explorations, thoroughly understood the subject, it was determined to put the work in hand by the route referred to, and special instructions for this purpose were issued from the War Department on the 15th of March, 1858. While this was being done, the co-operation and energy of the house of Chouteau & Co., of St. Louis, was enlisted to the extent of testing the extreme navigation of the upper Missouri. This daring project was attempted by Charles P. Chouteau, with a slight assistance from the government, and was crowned with complete success.

Simultaneously with these developments on the Missouri slope, events were at work at the sources and along the upper section of the main Columbia that were destined to eventuate in results no less important, and directly bearing upon this subject. The Indians of the Columbia had by some strange but united action risen to a tribe, determined to meet the fast approaching settlements from the east, and to measure strength with the whites, and strike a blow in behalf of their rights and property. The Indian war of 1855 and 1856, that converted each man's home in Oregon and Washington into a block-house, caused the portals of the upper Columbia to be opened awide, and brought especially to the attention of the people a hitherto neglected and little known region. Though the disturbance was quelled, the Indians to the east of the Cascade mountains were not subdued, but sought every occasion to show their disaffection, which thus finally culminated in the defeat of Colonel Steptoe. Such was the feeling after the war of 1856 that a military occupation of the Walla-Walla valley became necessary, and the rude mud walls of old Walla-Walla, that year after year had listened to nought but the jargon of Indians and traders, caught a new sound in the tramp of the march of civilization.

A new and unexpected element was thus introduced, which tended greatly to develop the upper Columbia. The question of supplying the large force in the field became one of great importance, and it was but natural to suppose that steam navigation could not long lie dormant and untested. Enterprise, energy, and liberal means were not tardy in converting forests into a steamer destined to plough this river to the very base of the mountains. Thus the year 1859 became a noted period in the history of the development of the upper Columbia and Missouri rivers.

While the above experiments, so pregnant with meaning, were being made at the two extreme sections, instructions from the War Department to commence upon the central link in the line of communication were received. I accordingly left New York on the 5th of April, 1858, and proceeded to Fort Dalles, Oregon. in pursuance to my instructions, designating this as the point for preparing my outfit. Further instructions were sent to General Clark, commanding the department of the Pacific, to furnish me with an escort of sixty men and such stores as were necessary for our purpose. All these having been directed by the general, I reached the Dalles the 15th of May, and, organizing my party, took up my line of march for Fort Walla-Walla, at which point my escort was to join me.

In the outfitting of my expedition, and in all things necessary for the success of my trip, I was cordially aided by Captain Thomas Jordan, (then captain in the army,) to whom I am indebted for all co-operation that it was in his power to accord—to him I return my sincere thanks. *Fiat justitia ruat cælum.* I had not proceeded further than the Five-Mile creek when the news reached me of the lamentable defeat of Colonel Steptoe on the Spokane plains, a point directly in the route of my intended location. The news, though much exaggerated, as is usual on the frontier, was such as to cause me to halt at this point till I could confer by letter with Colonel Steptoe regarding the strength of the Indians in the field and the prospect of my being furnished with an escort from Fort Walla-Walla, where he then commanded. To construct the wagon road while the Indians were in a state of open hostility was out of the question; but it was necessary for me to possess authentic facts before I could either move forward or break up the expedition. During the interval I occupied my men in building the bridges now over the Five-Mile and Ten-Mile creeks, and in otherwise improving the wagon road from the Dalles to the Des Chutes. On the 30th of May a reply was received from Colonel Steptoe, from which I judged it impracticable to prosecute the work this season. I therefore returned to the Dalles and disbanded my expedition, with the exception of Mr. Kolecki, my topographer, Mr. Sohon, my guide, and the men necessary to take care of my stock, reporting the facts immediately to the War Department.

On learning of Colonel Steptoe's defeat, General Clarke immediately determined upon retaliatory measures, and, with this view, promptly ordered to the field a well-appointed and well-equipped command, under Colonel George Wright, 9th infantry.

I had no disposition to remain idle during the summer, but, on the contrary, was anxious to become personally cognizant of such topographical facts as would give me a correct idea of the western section of the country through which our road would pass. I therefore addressed a communication to General Clarke, and offered the services of myself and party to join any command going into the field, stating that, having instruments and material, we were in a condition to collect and prepare any topographical facts and features that the march might develop. I would here state that the region lying between the Spokane and Snake rivers was only known to me through the reports and maps of others; and to say, *a priori*, where the line should or should not be located was no easy matter. General Clarke accepting the services offered him, I was assigned to duty on Colonel Wright's staff, as topographical officer, and, with my party, accompanied him against the Indians who had defeated Colonel Steptoe.

The movements of Colonel Wright form not only a part of the especial records of the War Department during 1858, but, being a part and parcel of our own operations, a detailed report thereof has been made by myself, and been published in public documents.

Colonel Wright's successful campaign terminating in 1858, I was once more left in a dilemma as to what course I should pursue. I had seen sufficient of the western approaches to the Bitter Root range to convince me that the physical difficulties were such that a longer period of time, more ample means, and a larger force of men than either myself or others had imagined were requisite to accomplish our object. Should I then remain idle during the winter, and, laying the facts in official reports before the bureau, await in hopes that they would be favorably acted upon by Congress; or should I go in person and solicit the aid and co-operation of those friends of the project who were in a position to give strength to their views by legislative action? The latter plan appeared the more plausible; and, though the fates seemed against us, I determined to make one more effort, pleading my zeal in justice of the course I took. I therefore returned to Washington, reaching there in December, 1858, and laid all the circumstances of the case, together with our new wants, before the War Department and the military committee. Governor Stevens, then in Congress, ever active in those movements that tended to develop the country, had already prepared the way for a favorable action on the part of many, and watched its progress with a daily helping hand, until we succeeded in our applications for additional means. In the month of March, 1859, the bill appropriating $100,000 for our work became a law, and new instructions were issued to me in the same month by the War Department. With these I again started for Oregon on the 5th of April.

The importance of overland communication, by either rail, wagon, or telegraph, had lost none of its weight or importance, either in the estimate of the government or the people who were to be benefited by them. I found that a communication with the north Pacific was one that the delegations from the northwestern States had made an especial study, and there were no facts bearing upon this region, collected or published, that had not been critically and carefully weighed by these gentlemen, whose constituents were to be directly benefited when these projects were consummated. I had the benefit of many interviews with those who were not only fresh from the field of similar duties, as in the case of Colonel Lander, but of those whose aid was finally requisite to breathe that vitality into our work necessary to its successful accomplishment.

My instructions left me a liberal margin for collecting all the facts that bore either directly or indirectly upon the question of a railroad location, to which our immediate work ultimately tended. We reached the Dalles again on the 15th of May, where, organizing my party, I took up the line of march for Fort Walla-Walla. My escort this season had been increased to one hundred men, who were detailed from the companies of the 3d artillery, then at Fort Vancouver, accompanying which were Lieutenant James L. White, Lieutenant H. B. Lyon, and Lieutenant James Howard, 3d artillery, all of whom joined me for duty at Fort Walla-Walla the 28th of June.

There was a point to which I desired to give especial attention in the earlier part of our exploration, and that was to run a line of levels along the bank of the Columbia to the Snake river, from the Dalles, and thus obtain some well-based data, that would determine the feasibility of a railroad line by this route. No instrumental line ever having been run here, it was necessary that this link be supplied.

Knowing that our labor would be comparatively light and easy over the western plains, to the mountains, I found I could judiciously divide my force, and consequently organized a small but efficient party under the joint command of Captain W. W. Delacey and Conway R. Howard, civil engineers, both of whom brought to bear that experience gained on eastern railroad lines that would render their conclusions of value. Their report is herewith appended, marked A and B. It is apparent that the most difficult section of the line exists from the Dalles to the Des Chutes; but this portion is now being rapidly covered by a railroad under the auspices of the Oregon Steam Navigation Company, which will be in running order by May, 1863, this being made over the portage, to connect with steamers on the upper and lower Columbia. The remaining portions offer most marked advantages for location immediately along the bank of the river, which lends itself as an all-important aid in the construction of the road. The examination was made along the Oregon side, but the survey would tend to show that the Washington side offers the superior advantages.

The reports of Captain Delacey and Mr. Howard are full as to facts and details of construction, pointing out special points of difficulty, and as to mode of handling them. Depots of material, sand, wood, stone, and lime are referred to, and the especial advantages enjoyed by the location are dwelt upon by them with emphasis, and to all of which I invite attention and study. The gentlemen did their work thoroughly, and here have my thanks for the same.

While organizing my expedition at the Dalles, a command of two companies, under Major Lugenbeel, was directed to proceed to Fort Colville, for the double purpose of giving protection to settlers in that quarter and putting on foot such movements as tended to facilitate the work of the northwest boundary survey party, then in the field. Major Lugenbeel requested me to let Mr. Engle, one of my topographers, accompany him in that capacity to Fort Colville, and after taking a copy of the facts collected by him they should be turned over to me. Acquiescing in this request, Mr. Engle so started, and the map of that line is his work, and the principal features of the route travelled are described in the extracts from his report of the same.—(See Appendix.)

This trip of Mr. Engle tended to give us a truthful map of the country from the mouth of the Palouse, a common point of our present road and the Colville road, to the lower Spokane crossing, and which thus enabled us to map properly the entire Columbia plain. It also gave us the region towards Fort Colville, by which we connected our later work in the summer of 1859; and the fixed position of Colville having been determined by the northwest boundary survey, we were enabled to have a check upon our branch lines of reconnaissance. Mr. Engle's report treats in much detail of this route, the natural advantages that it enjoys, the especial improvements required upon it, and the distances and campgrounds are all referred to with great accuracy.

While at the Cœur d'Aléne mission, in 1858, I brought up anew to the fathers the subject of the route leading from the headwaters of the Palouse to the Bitter Root valley, referred to in former pages as supposed to be known to the Indians, requesting them to obtain for me any facts that would guide me in its exploration. In compliance with this request, Father Josét sent me, while in Washington, a letter which caused me to set on foot a project of surveys that would afford the authentic facts. The instructions of 1858 and 1859 from the Topographical Bureau, directed me to pursue a line which, leaving the Snake river at the most eligible point, should cross the Spokane plains northeasterly, skirting the Cœur d'Aléne lake at its southern edge, and reach the Cœur d'Aléne mission *via* the valleys of the Cœur d'Aléne and St. Joseph rivers, and thence take the line that I had reported in favor of in 1854. But the reception of this intelligence caused me to weigh the letter of my instructions against the feasibility of finding a shorter, better, and more economical line *via* the route set forth by the Fathers knowing, as I did, that the instructions of the department were simply based upon the best information then had of the country and not intended to govern me absolutely, if a better and shorter line could be found.

Having directed Mr. Weisner, my astronomer, to proceed from the Dalles to Fort Walla-Walla, and there establish an astronomical station, I instructed Mr. Sohon to accompany him from the Dalles, availing himself of the necessary aid to proceed to the country of the Cœur d'Alénes; there securing such guides as had been promised by Father Josét in his letter and other reliable persons knowing the country, to proceed to explore it in order to give me on crossing Snake river such information as would guide our future movements. With this object Mr. Sohon started from the Dalles on the 5th of June, and his more detailed movements are contained in the appended synopsis from his official report.

Mr. Sohon's early connexion with my explorations in 1853 and 1854, his knowledge of the Indian language, his familiarity with the general scope of country to be traversed, and the influence he had always so beneficially exerted over the Indians, all pointed him out as the proper person to explore the new and dangerous region.

His mission was put on foot, but bitterly opposed by the Indians. He kept me advised from time to time of his position and progress, and it was only after being convinced from his several reports that the country was impracticable and his life threatened by the Cœur d'Alénes, that I determined to withdraw him and give up all hope of finding a route further south than that by the Cœur d'Aléne mission. It was evident from the explorations that had already taken place that the mountains to the south of the Cœur d'Aléne river, until you reach Salmon river, were high, difficult, and probably impracticable for a wagon road, and we were forced, from the topography of the country, to turn this immense bed of difficult mountains by either a line to the north, which takes us by the Clark's

Fork, or by the extreme south, taking us near the head of Snake river, thence tending northward at the Three Butes, at Fort Hall.

I was determined, however, to satisfy myself as to the true nature of the country lying between the Clearwater and St. Joseph's river, to which I felt favorably disposed, from a conversation with General Stevens, who represented the valley of the Palouse, at its point of intersection with a line drawn from Cœur d'Alène lake to Lewiston, as being not less than twenty miles broad, and extending eastward from this point seventy estimated miles. This caused us both to think that this valley would, at the headwaters of the stream, lend itself as a favorable location for a road to the Bitter Root valley; but the governor over-estimated its true value; I do not think that a route can ever be had in the direction we so much desired to find one.

The different parties of Messrs. Sohon, Engle, Howard, and Delacey, started from the Dalles in advance of my main expedition, which left on the 15th of June, and, following the usually travelled wagon road, reached Walla-Walla by the 28th of June; tarrying there for temporary repairs and additional outfit, we again started on the 1st of July. A portion of our supplies were forwarded to the mouth of the Palouse by the steamer Colonel Wright and the remainder transported by wagons to the same point, under general charge of Lieutenant Lyon, 3d artillery.

The question of wood and water between Walla-Walla and the Snake river caused me, during this season, to locate the route *via* the mouth of the Toukanon, the spirit of our work looking simply towards having a low-water route, or one that summer travel alone demanded; and as, along this line, the distance between water was much shorter than *via* the mouth of the Palouse, I was governed by these considerations in its location. The general character of the route is similar to that of the Palouse—a high rolling prairie region—but it is shorter by two miles. The country in this section possesses remarkable advantages for grazing, the long red bunch grass giving pasturage to numberless flocks of sheep and horn stock, while the valley bottoms are sufficiently large and fertile to afford not only ample means for the graziers, but could supply the local wants and travel of the country. The creeks found in this length of forty-eight miles are, the Dry creek, eight miles from Walla-Walla; the Touchet, twenty-one miles; the Red creek, thirty miles; and the Toukanon, forty miles.

Already have each and all these valleys become the comfortable homes of the pioneer farmer and grazier, where the hand of industry, adding daily to the wealth and prosperity of the country, gives a new beauty, by the erection of school-houses and churches, those barometers of the intelligence and morality of a people.

The waters of the streams flow directly from the snows on the mountains that girt them, and, when the wants of the country demand it, an abundance of good mill sites can readily be found. The pure water, free from all alkaline elements, cannot be too highly appreciated by the stock raiser. We reached the Snake river, at the mouth of the Toukanon, on the 3d of July, and, being delayed in swimming our stock, were not able to proceed until the morning of the 4th, on which date we took up our line of march for the valley of the Palouse at its southern bend.

Mr. Sohon, having crossed the Snake river at the Red Wolf's crossing, and returned to the mouth of the Toukanon *via* the valley of the Smokle creek, left the section of the Snake river between these two crossings unexplored, so that, in order to correctly map the river and the circumjacent country and connect his survey with my own, I was obliged to send Mr. Engle, now returned from Colville, to examine and report upon this line, and a description of its features is contained in his appended report.

The general character of the country from Walla-Walla to the mouth of the Palouse is an easily rolling prairie; road excellent; camps good, with fine water and most abundant grass. The valley bottoms are nearly all densely settled; the land in the bottom being sufficient for farms of considerable size, and the hill-sides bowed down in beauty under their loads of most excellent and nutritious grasses. We built bridges over the Touchet and Dry creeks, and over a slough three miles from Walla-Walla; also making slight repairs where needed. With these improvements the road is a good one. Crossing the Snake river without accident, save the drowning of one of my men, who, in rafting wood down the stream, was caught by its impetuous current and swept out of sight before aid could reach him, we moved from the river on the morning of the 4th of July, and after a severe march of fourteen miles reached the Palouse at its junction with Cow creek. At this point we found Lieutenant Lyon encamped, awaiting our arrival, having moved from the mouth of the Palouse, where our supplies had been debarked.

The line from Snake river to this point of the Palouse is over a rolling prairie region, six hundred feet above the river, which at the point of crossing is nine hundred feet, and flows through high, broken, basaltic, bluff banks; at its intersection with the Toukanon is the site of Fort Taylor, built by Major Wyse, of Colonel Wright's expedition, in 1858. Wherever work was required *en route* from the Snake to the Palouse it was done, consisting of slight excavations made by the men while the train was moving.

Our different parties having come together on the 5th of July, we moved eastward up the left bank of the Palouse for six miles, when, fording, we followed its right bank for a mile, to a good camp, and halted for the day. The general width of the valley is from a half to a mile and a half wide, about a hundred feet below the general level of the prairie country around, and bounded on both sides by abrupt bluffs, from which crop out at many points basaltic rock, the general formation of this region. Only willows and a few cotton woods fringe its borders. The soil is mostly a black loam and will doubtless produce cereals and vegetables; but the absence of timber is an impediment to its settlement that cannot be easily met. At the headwaters of the stream and its tributaries limestone is said to be found, and there also, in places, the soil is fertile, and lying, as it does, under the slopes of the mountains, and in close proximity to the Nez Percés mines, it is not at all improbable that the grazier and agriculturist will find at no distant day tracts of land that will amply repay their reclamation.

July 6.—Making another ford, we moved along the valley bottom two and a half miles, when, finding more labor required than could be attended to while the train was in motion, we encamped until the morning of the 9th.

Our work consisted in grading along an abrupt side-hill in loose rock and clay to avoid additional crossings of the Palouse, always difficult, and particularly so when the stream was swollen. At all the fords the current was swift, running over rocky and pebbly bottoms. It was a question with me whether we should follow the main valley of the Palouse or strike across the high prairie country and go by the way of the upper tributaries of this stream; by the former we pass to the south of the direct line to the Cœur d'Aléne, and thus go by way of the camass prairies, near the headwaters of the Nedlwhuald, and by the latter to the north of the Pyramid butte. As the country had not been examined in detail, I deemed it best to avail ourselves of our delay at this point and send Mr. Kolecki forward to explore it and obtain some authentic facts. From the summary of his report (appended) I determined to take across the high prairie country, as no doubt was left upon my mind but that a route to the north of the Pyramid peak was the better as well as the shorter. Therefore on the morning of the 9th of July, our work being completed, the train moved forward a distance of five miles until we reached and crossed the Mocalisiah, the principal tributary from the east, making in this distance three fords of the Palouse.

On Monday, the 11th of July, resuming the march across the prairie country for 13.4 miles we reached the Oraytayouse, the northern fork of the Palouse. In the interval we had a good road, over a level prairie for the most part, and but little work required *en route;* springs of water were found in the plains and copses of willows at one point sufficient for a small camp. The water of the Oraytayouse was very shallow, being only eighteen inches deep, and with its good grazing, willows for fuel, and pines within a distance of a mile to the east afforded us a good camp. Distance from Walla-Walla ninety-six miles.

On Tuesday, the 12th, of July continued the march for sixteen miles, reaching a camping on the Tcho-Tcho-u-Seep, a tributary of the Oraytayouse. The prairie country afforded us a good location; springs of water were passed on the route; no work of note was necessary. At this point we entered what might be termed the more difficult section of the basaltic basin, which constitutes the chief characteristic of the Spokane plains, and hence it became of marked importance to feel our way by examinations in advance that would guarantee to us the best locations. The general face of the country, as well as the map of the line, tended to show that our more direct route was in a direction eastward from our present camp towards the Cœur d'Aléne lake; but to be assured of this I sent Mr. Sohon forward, with a Cœur d'Aléne Indian as guide, whom chance had brought to our camp, to make a preliminary examination. On exploring it he found the ground so cut up by deep basaltic cañons and ravines, with the bed of the Spectre lake intervening, that we were necessitated to take a more northerly course, and therefore, on Wednesday, the 13th of July, we moved forward over a generally easy prairie region interspersed in places with flat basaltic rock and copses of pines for a distance of nine miles, when we reached and encamped upon the Sil-Sil-cep-pow-vetsin, one hundred and twenty-one miles from Walla-Walla. The cañon of this creek at our point of crossing it was rocky in the extreme, so much so, indeed, that when once into it, it required nice engineering to get out. Half a mile back from the cañon good grazing fields are found, which, together with the abundance of timber on the borders, will always make it a good camping ground. No other capabilities, except grazing, are here found. A few acres of good soil of inconsiderable extent occur but not sufficient to make it an object of especial note.

On the 14th of July, leaving the cañon of the Sil-sil-cep-pow-vetsin, and gaining the higher level prairie country in an elevation of one hundred feet, we found a good location for the road, requiring light work in places, for about sixteen and a half miles, when we reached the Lahtoo, or Nedlwhuald creek, which last empties into the Spokane. It is thus seen that on this day's march we cross the prairie divide that separates the waters that flow into the Snake from those that flow into the Spokane; but by a rise so gradual as to be almost imperceptible, except to the barometer. This interval of sixteen miles is a swelling prairie, well grassed, with here and there good tracts for settlement, though the general scope of country is unsuitable for culture. Timber is in sight nearly the whole distance, and though this section will probably never be continuously cultivated, still it offers many inducements for graziers and farmers, and enters as an essential element in affording good sites for mail and recruiting stations, by the fine grasses now found and the abundance of forage and supplies it is capable of producing under the hand of an industrious and diligent culture.

We encamped this day on the banks of the Nedlwhuald, and at the same point where General Wright hung Qualtian, the noted Yakima chief, and several other Indians; from which fact the stream is known to many as Hangman's creek. Poor creatures! their doom, although in this instance a just one, is, nevertheless, pitiable; had the white man been to them more just, fate had proved less harsh.

Our route of this date skirts the lake from which Colonel Steptoe retreated the day of his noted defeat at the hands of the Cœur d'Aléne and Spokane Indians. We crossed Nedlwhuald on the morning of the 15th of July at the point of our encampment, although another crossing is found one mile above this point. This stream is subject to very high rises in the spring freshets; its banks in places are low, in others, bordered by high, rocky bluff banks, and fringed with groves of open pines. The lower sections are not favorable to settlements, but nearer the mountains its valley widens, and offers inducements for small farms here and there, with rich grazing, fine timber in abundance, and water in creeks and springs of the most delicious purity. Leaving the Nedlwhuald, the road, for three miles, passes over gently swelling hills, when it reaches a prairie swale or bottom two miles in length and one in breadth, whence, in seven miles more, we reached some pools of water fringed with cotton woods and pines. After halting to improve the road, we journeyed on through an open prairie basin for seven miles to some wells, where, being provided with wood in our wagons, we made camp for the night. This portion of the route may be termed a natural wagon road, needing but very slight improvement.

It was on this day that we met, for the first time, a band of the Cœur d'Aléne Indians, under Pierre, a few miles from our camp; they were well mounted, anxious to learn our mission, our line of direction, and plied us with many questions as to our ultimate ends and objects. A few of these Indians were also met by Mr. Sohon in his exploration toward the head of the Palouse. Discretion and prudence directed that our course towards them should be both frank and honest. I invited them to accompany me to my camp, gave them to eat and to smoke, and afterwards explained to them in detail our mission and object; they left, apparently satisfied, and with a promise to preserve friendly relations in future. They are wily fellows, and great caution is necessary in all intercourse with them.

On the morning of the 16th of July we resumed our march; moving eastwardly for nine miles over an easily swelling prairie region, timbered for the last three miles, to a point which I had selected for a depot camp, while our work was progressing in advance. We had left the plains of the Columbia proper, and reached the spurs of the Bitter Root mountains, where our more difficult work commenced.

We had chosen for our location a line which, jutting upon the southern edge of the Cœur d'Aléne lake, would follow up for four miles the valley of the St. Joseph's river; when crossing it would take the most direct line across the divide to the Cœur d'Aléne river; thence up the valley of that stream to the Cœur d'Aléne mission.

Our first work of difficulty was to make the descent of seven hundred feet from the table land to the valley of the St. Joseph's Several points were examined, but none afforded a natural descent, and I was forced to work one over a long spur making down to the lake at the juncture of the St. Joseph's river with the outlet of the Poun lake. Over this outlet a bridge of sixty feet was constructed. This piece of excavation was rocky and difficult; but, with the bridge, was completed in eight days. I then moved the entire camp up the valley of the St. Joseph's to the point selected for crossing. The St. Joseph's and Cœur d'Aléne rivers are the two arms and feeders of the Cœur d'Aléne lake. They rise in the Bitter Root mountains, between sixty and seventy miles to the eastward, and during their greater length are characterized by flowing with a rapid mountain current, in a narrow timbered gorge of cañon-like formation, till losing their impetuous current the valley widens, the current slackens to dead water, the stream becomes from twenty to forty feet deep, with banks almost six feet above low water mark, but which, unfortunately, in high freshets, are overflowed, and to which overflow we failed to give a just estimate during this season, and which will be referred to hereafter. While building the bridge over the Poun lake, we observed that during the earlier part of the day a slight current up stream was perceptible, sufficiently so to move the bridge timbers, while late in the day it moved in the opposite direction.

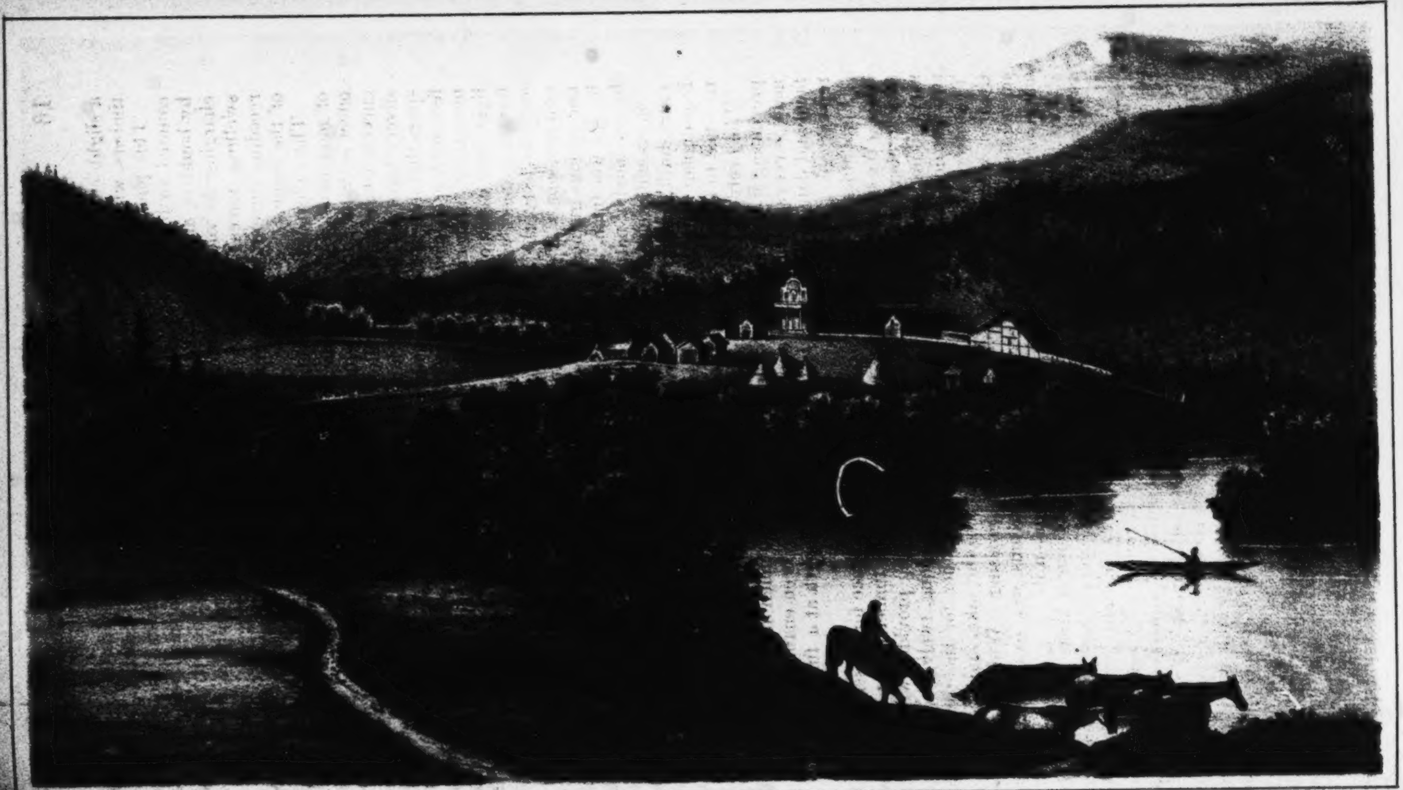
This phenomenon is only to be seen during the freshet months, and is accounted for by the fact that the outlet of the lake is so small, and so obstructed by boulders and rocks that dam its waters, as to render it incapable of discharging the volume of water as fast as the feeders supply it; hence the lake, swelling, forces a certain volume of water back, giving the appearance of a receding current, this changing again as soon as the lake has discharged itself of the surplus.

The valley of the St. Joseph's is a beautiful gem, embedded in a noble range of mountains. Viewed from an elevation, on a summer's day, the scenery and effect is grand and picturesque—the river winding from side to side in graceful curves, while copses of willow, cottonwood, and alder fringe its banks, and silvery lakes dot here and there the green sward in which it is clothed. The spurs that form its either boundary, gently rising to an elevation of a thousand feet, are densely clad with one of the finest growths of fir and pine to be found in the mountains; and, enlivened, as it is, with here a camp of hunters and there the light bark canoe of the Indian, forms one of the most beautiful scenes it was our fortune to meet with in the Rocky Mountains. It was in this valley that, as early as 1842, the Jesuit Fathers chose a site for the first of their Rocky Mountain missions. A small plateau, projecting into the valley from the north, where fine springs gushed from the slopes, on which the forest lay as yet untouched by the woodman, and a rich virgin soil smiled in a beauty of profusion, cultured by the hand of nature alone, offered them a choice garden, that, with slight attention, should yield abundant fruits. Here they maintained themselves for many years, until, finding the overflow of the lower portion of the valley entered as an impediment both to pleasant travel and to the extension of their fields, they removed to their present location on the Cœur d'Aléne lake.

The overflow of the Cœur d'Aléne and St. Joseph's rivers, and the means of preventing it, is a subject to which I have given much attention; and having made surveys, both in high and low water, I have been enabled to collect many facts and data, which I will treat of at greater length at a future point of my report.

Four miles up the valley we selected a suitable place for crossing by a ferry-boat. We immediately set the whip-sawyers in the timber to get out the necessary lumber, and some men to burning tar, and, being provided with the necessary oakum, we built two flat-boats, forty-two feet long, twelve feet broad, and two feet deep—one for the St. Joseph's and the other for the Cœur d'Aléne. The latter, when completed, was rowed down into the lake, and thence up the Cœur d'Aléne river to the point selected for its crossing. While this was being accomplished, the divide between the two streams was examined, the road marked out, and several parties placed at work upon it.

The distance from the St. Joseph's to the Cœur d'Aléne is twelve miles, passes through a partially timbered country, and gives a good location. Indications of gold were observed, and much quartz scattered over the ground. Springs of water occur at convenient distances, and small tracts of land capable of cultivation. Game, consisting of bear and deer, were occasionally found, and an abundance of mountain grouse. This work, from the St. Joseph's crossing, involved the building of a corduroy, four hundred feet long, over a wet section of the river bottom, and a heavy excavation up a suitable spur, in order to gain the divide, seven hundred feet above. This entire work occupied our force until the 5th day of August, 1859. During this interval our topographers were engaged in tracing the St. Joseph's to its sources, in the Bitter Root mountains, marking its tributaries and defining its boundaries; also in making a survey of the Cœur d'Aléne lake. This last is a noble sheet of water, about eight by twenty-two miles in extent, with a depth of from fifty to fifty-five feet, and



Drawn by C. Schon. Bowen & Co. lith. Philada.

COEUR D'ALÊNE MISSION IN THE ROCKY MOUNTAINS.

bounded on all sides, except at the points of juncture of its arms, by high, sloping timbered spurs. It is about two thousand feet above the level of the sea, and filled with an abundance of delicious salmon trout. The line to the Cœur d'Aléne river being completed by the 5th of August, I moved the entire train to its left bank, where it remained in camp until the 9th, when the road, for nine miles up its left bank to the point of crossing, was completed. This work consisted of a side cut of a fourth of a mile along a broken, rocky spur, jutting upon the river's edge, building three bridges, and cutting through a slight growth of timber near the point of crossing. Our boat being in readiness, we crossed the river on the 10th, and remained on the left bank until the morning of the 16th, engaged with our entire force in opening the line thence to the Cœur d'Aléne mission, which involved building three bridges, making a cut of one mile of excavation along difficult spurs, and cutting through timber for three miles, which, when completed, gave us an excellent road. On the morning of the 16th of August we reached the mission, two hundred miles from Walla-Walla. This was one of our fixed points from which began our mountain work proper. That this proved a difficult task to handle our three years' labor abundantly proves. I would here state that the same features mark the valleys of the St. Joseph's as characterize that of the Cœur d'Aléne—fine tracts of land for settlement, abundance of timber, and most excellent grazing, with mill sites on many of the smaller tributaries.

Reaching the mission we determined to make it a depot point for our train until such time as our work in advance should enable us to move forward.

Placing the depot under the charge of Lieutenant White, we divided our force into several sections and distributed them along the line of work for ten miles. This work consisted of timber cutting and clearing, building small bridges, corduroying wherever the ground was wet and marshy and making side cuts wherever it was sidling, or where the formation of the spurs compelled it.

Crossing the Cœur d'Aléne a mile above the mission we lose sight of the river till reaching the Four-Mile prairie, a point four miles beyond, and again lose sight of it until reaching a point we called the Ten-Mile prairie. This section of the road, for the first four miles, passes mostly through a timbered region and along the south foot of the spurs, making back from the river, till it reaches the Four-Mile prairie; after which it again enters a timbered region till reaching Seven-Mile prairie, and then again through timber until it reaches Ten-Mile prairie. Each of these prairies afford good camp grounds, and the first was formerly cultivated by the Fathers; this soil is good; it contains about one hundred acres. Seven-Mile prairie is an excellent cramping ground but not so well suited for cultivation; it is abundantly fed by springs and creeks, and contains about four square miles; traces of gold are said to have been found here. Ten-Mile prairie has many springs and is very wet in the early part of the year; it contains about a square mile, and is bounded on one side by timbered spurs and on the other by the banks of the Cœur d'Aléne, fringed at this point with pine and cottonwood; it produces a rich growth of meadow grass, and its soil in places is alkaline; it might be reclaimed by ditching, and would then be a fertile and desirable spot. We chose this as our second depot, as it afforded us a good grazing range for our stock; and from it we also cut a quantity of hay. The work from the mission to the Ten-Mile prairie occupied us until the 17th of August, when we again brought forward our entire train to the new depot. Every one was moved except the astronomical party under Mr. Weisner and Mr. Kolecki, who were left at the mission during a lunation to fix the position of that point. Our position at Walla-Walla had already been determined by a six weeks series of observation, and our plan was to occupy as many fixed points as time and circumstances would allow.

While at the Cœur d'Aléne mission we had sent out two parties to explore and bring back such data as would guide our judgment in our further movements.

The one was assigned to Mr. P. M. Engle, whose duties were to cross the bed of mountains along the south fork of the Cœur d'Aléne river, and strike the Clark's Fork at or near Thompson's prairie, in order to see if the country along this route was adapted to a cheap location. In this undertaking he was provided with the necessary Indian guides and outfits, and directed to pursue his examinations up the Clark's Fork to the Pend d'Oreilles mission, and return *via* the route of the Bitter Root, recrossing the mountains *via* Sohon's Pass and thence to our camp. This was fully and satisfactorily accomplished, and developed the fact that the features of the mountains precluded the possibility of securing a line in that direction. The second party was placed in charge of Mr. Sohon, with directions to pass rapidly forward and mark in a general manner the location; to ascertain the best point of passage over the Cœur d'Aléne mountains, and to continue his examination down the valley of the St. Regis Borgia to the Bitter Root, and thence up it to the Hell's Gate valley. For this purpose he, too, was provided with the best Indian guides we could procure, and fulfilled his mission satisfactorily, returning to camp by the 15th of September.

From my own knowledge of the country, and the additional data brought in by Mr. Sohon, I saw that we had to content ourselves with the cheapest location that the peculiar features of the valleys of the Cœur d'Aléne and St. Regis Borgia warranted. Both of these valleys were densely timbered, with here and there a prairie affording scanty grass. Both of the valleys at points verged towards cañons, and their rivers were serpentine in their course, leaving alternate flats and spurs along their banks; hence the character of the streams necessitated frequent crossings or long and difficult side cuts to avoid them. The latter was a work of great magnitude, and incompatible with the means at our disposal; hence the former was our only alternative. Our work, consequently, from the 16th of August to the 4th of December, 1859, consisted in cutting through this densely timbered section of one hundred miles, building small bridges where required, and grading in thousands of places, made necessary by the physical nature of the country. We likewise graded an ascent of one and three-fourths miles, to the summit of the Cœur d'Aléne mountains.

This work was heavy, and in so brief a report as herewith given justice cannot be done to the industry and fortitude of the men while mastering this wilderness section.

The standing timber was dense, and the fallen timber that had accumulated for ages formed an intricate jungle well calculated to impress one with the character of impracticability. Suffice it to say that we mastered the many difficulties with which its construction was fraught, and reached our winter camp in the St. Regis Borgia valley on the 4th of December.

As we had been obliged to keep our stock in the mountains until they were covered with snow, many had died from starvation and exposure. I had at first intended to reach the Bitter Root river, but winter overtaking me, I did the best in my power, and made a point on the St. Regis Borgia below the last crossing. It was to attain this that I pushed my stock to the last point of endurance, dreading to be caught in a mountain gorge to battle out the winter, or to contend with the high water of the coming spring. As stated previously, we did not reach our winter camp until the 4th of December, and already had our men worked in the snow at great discomfort, though with cheerfulness and zeal.

Becoming settled in our camp, we forwarded our stock to the Bitter Root valley, but the distance was one hundred miles, the ground covered with snow, and the mountain trails difficult and slippery; these, together with their enfeebled condition, caused the loss of the greater number of them before they reached the valley; but there was no point for pasturing short of this, and they must either reach it or perish in the snow. I took the precaution to have the beef cattle driven to camp and slaughtered and the beef frozen, in which condition it kept until the month of March. The truth was that the amount of work required was immense, and very much under estimated both by myself and others, for we only truly appreciated it when we came to handle it in detail. It was completed, however, by our party, with an industry and interest seldom evinced on similar occasions.

We occupied the summit of Sohon's Pass for a period of six weeks with our transit, and determined its position with great accuracy. From this point it was sent to the crossing of the Bitter Root river, which we occupied from November until April, and here obtained a very important fixed point.

Early in November I sent Mr. Engle forward to the Bitter Root valley, there to organize a small party and proceed to Fort Benton, mark the general features of the line, and bring me back such data as would control my judgment in future movements.

Our men were set to work erecting such log huts as our wants demanded, and to the camp I gave the name of Cantonment Jordan. It was situated in a dense bed of timber, that furnished both building material and fuel, had many fine springs, and was securely sheltered from the winds by friendly rims of mountains. We erected an office, and occupied the entire winter in compiling field-notes, completing maps, as far as our material sufficed, and writing such memoirs and reports as would furnish the bureau with exact information on all points connected with our operations. The office hours of employés were from 10 a. m. to 3 p. m., and from 6 till 9 p. m. The men were employed in gathering and preparing fuel, and the ordinary labors incident to camp life. Guard duty was kept up merely to preserve discipline, as the snow was an effectual barrier against Indian depredation or Indian surprise.

The question of snow had been with me an all-important one, and with the view of arming myself with facts as to its fall and depth, I had snow gauges prepared along the route, either by cutting off the tops of trees or planting posts graduated to a scale of feet and inches, so that when the mail-men passed, which they did every month, they might accurately note its depth. I have had this done during two winters, and am enabled to state definitely the depth attained during any month at every point of the route.

These show that in the upper Cœur d'Aléne and St. Regis Borgia valleys it fell to the depth of from two and a half to three feet; in the higher portions to from three to five feet, and on the summit of the mountains to from seven to nine feet. This is an objection to this route of so vital importance, when compared with that *via* Clark's Fork, that, as I before stated, had I known in 1854 what I did not learn till 1859, I should, by all means, have recommended the latter, at least, as far as regards the portion lying between Antoine Plant's and the Hell's Gate. During the winter of 1859, Spokane Garry brought the mail by the way of the Clark's Fork, and though he lost one horse en route, yet he nevertheless made the trips mostly on horseback. As soon as this fact was brought to my notice, I set an inquiry on foot and found this fact to hold: that no Indians had ever been known to cross the mountains in winter, *via* the Cœur d'Aléne route, while it was quite an usual thing for them to do so *via* the Clark's Fork. Further investigations of this point have proved of marked value, and must enter as essential elements into the location of any railroad line that would seek the Columbia *via* its upper tributaries. We find this meteorological fact to exist: that if we take the isochimenal line which crosses the country in the latitude of St. Joseph's, Missouri, and trace this line westwardly, we reach Fort Laramie, when, varying from the line of latitude, it trends northwestwardly and passes between the Wind River mountains and the Black Hills of Dacotah, reaching the headwaters of the Yellowstone, at the hot spring and geysers of that stream; thence again to the Beaver Head valley, crossing the main range of the Rocky Mountains at the Deer Lodge valley, in latitude 47° north. In other words, in the longitude from St. Joseph's to the Rocky Mountains it has gained six degrees of latitude, which remarkable increment continues as we trace it further westward; for the line crossing the range grasps the valley of the Hell's Gate, and keeps it till it reaches the Bitter Root, and thence, trending northwestward, strikes the Clark's Fork at the Pend d'Oreilles lake; from this point it trends south and comes down to the Walla-Walla, in Washington Territory. Thus we find the same climate along the Clark's Fork, Hell's Gate, upper Missouri, and Yellowstone rivers, that we find at St. Joseph's, Missouri.

This is as true as it is strange, and shows unerringly that there exists in this zone an atmospheric river of heat flowing through this region, varying in width from one to one hundred miles, according to the physical face of the country. This affects the kingdoms of natural history, botany and climatology to such an extent that herein we find mild winters, vigorous grasses even in midwinter, that enable stock to be grazed on the open hills, and gives a facility of travel during the severest seasons of the year.

There is no doubt in my own mind that this fact will yet be turned to a practical utility to the extent of opening this route by a wagon road, when the mail coach and the emigrant wagon can, each and every month, make the trip overland from the Missouri to the Columbia. This line once opened would prove the great pioneer to the railroad which is destined to tap the interior of the northern mining section of the Rocky Mountain system, and which will have its outlet to the north Pacific either *via* the mouth of the Columbia or Puget Sound. The effect of this important fact had a material bearing upon the time of our resuming work in the spring of 1860. The point chosen for our winter camp was fifteen miles from the Bitter Root ferry, through a densely timbered section, involving heavy labor. The winter at the main camp proved severe, while at the ferry it was generally mild and pleasant, with less snow by one and a half feet, and, although only fifteen miles distant, like a new climate. In fact, to compare the climates of these two points was like the difference of spring and winter, for one was situated within this river of heat and the other without it. So apparent was this difference in the month of February that I could resume work with advantage along the Bitter Root river, whereas the snow and frozen condition of the section from my camp to the ferry rendered it impossible to work this till late in the spring.

I determined at once to throw forward all my men upon the Bitter Root, there build boats for the transportation of our supplies up the river, and resume work. We could not use our animals, as their condition and the want of grass would not allow of their being brought down to us at so early a date. To carry our supplies this distance of fifteen miles by hand involved much hard labor. The men transported on their backs two months' supplies, all their tents and personal baggage, and setting to work at the crossing got out the necessary lumber for six bateaux and a large flat, the last to be permanently left at the crossing, and the former to be used in transporting our supplies and baggage up the river as our work progressed. The location for thirty miles lying immediately along the right bank gave us every facility in moving camp. The different sub-parties were arranged with a view to efficiency, each under the supervision of a chief, to whom, as I was about to leave the party for a period to visit the Indians to the east and prepare for my spring and summer movements, I gave certain instructions, which are herewith appended, and which set forth the nature of the work. I then placed the whole command under charge of Lieutenant J. L. White.

During the winter months my mind was much exercised in regard to the time when I should reach the Missouri, and whether the summer of 1860 would not prove a proper time for carrying out the project originally set on foot by Jefferson Davis, and promised to be carried out during Mr. Buchanan's administration, namely: a military movement *via* these two rivers, Columbia and Missouri, and the route we were then opening. The success of such a movement would prove conclusively that a *result* had been obtained. I felt sanguine that we should reach the Missouri by the early summer. The success of the steamers in reaching Fort Benton in 1858 and 1859 was one point accomplished. Looking upon the necessity of the companies then serving in East Oregon and Washington being replenished in numbers by the coming summer, and the fact of my reaching Benton in the spring with a large and empty wagon train which could be judiciously and advantageously used in connexion with such a movement, I thought the spring of 1860 was, above all other periods, the proper time for testing the merits of our road. With this object in view I despatched to Washington Mr. W. W. Johnson, a young man then in my employ, whose thorough knowledge of the work pointed him out as a suitable person to perform what I desired. He left my camp for Washington city, with letters for the Secretary of War, Topograpical bureau, General Jesup, and Governor Stevens, setting forth my views in full detail and pledging my energy and determination that nothing should be left undone to secure the full success of the movement recommended; this was to send three hundred recruits from St. Louis to Fort Benton in the spring by the steamers of P. Choteau & Co., with four month's supplies, and that I would meet them at Fort Benton with my train, with which they could make the trip to Walla-Walla in sixty days. It is needless to narrate all the details that followed my recommendation, nor the various difficulties that beset our pathway to the right and left on the part of callous and apathetic persons, nor those that had to be handled from the inception of the enterprise to its final completion. Suffice it to say, the movement was ordered, its details and management were judicious, and three hundred recruits, shipped direct from St. Louis, supplied the vacancies in companies then stationed in East Oregon and Washington, at an estimated saving of $30,000 to the government. This movement had the effect of keeping in subjection the turbulent disposition of the Indians, transforming, while en route, recruits into soldiers, affording protection to the emigrant, security to the pioneer settler and tiller of the soil, and giving a practical test of the value of a route which, from the days of Jefferson, who initiated the project of opening a north Pacific communication, to the present date of its practical accomplishment, has had zealous friends and advocates.

Having perfected all the details for resuming work in the spring of 1860, and seeing the parties duly engaged, I proceeded to the Bitter Root valley and held a talk with the Indians, whose dispositions towards myself had always been friendly. The necessity of getting my supplies from Fort Benton, and the condition of my own animals, compelled me to lay my wants before the Flatheads. I told them I needed one hundred and seventeen horses, with pack saddles, and from fifteen to twenty of their men to accompany Mr. Sohon across the mountains. They promised me a reply the next day, when they would send me as many sticks as they had men and horses to furnish.

The next morning their chief, Ambrose, came to Fort Owen, where I was a guest, with a bundle of one hundred and thirty-seven sticks, each representing a horse or a man. Such nobleness of character as is found among some of the Flatheads is seldom seen among Indians; and I here record to their credit that I never had a want but which, when made known to them, they supplied, and that they always treated myself and my parties with a frank generosity and a continuous friendship.

They were paid for the use of their animals and the services of their men, and made the trip in the month of March safely across the Rocky Mountains, bringing me back eleven thousand rations. I also despatched from this place an express to Salt Lake, making a requisition upon Colonel Crossman for fifty mules. My expressman, Ned Williamson, was caught in the mountains by deep snows, near the head of Snake river, lost his horses, made snowshoes from his saddle rigging, and, though snow-blind for several days, made the greater portion of the five hundred miles on foot, reaching Camp Floyd safely, and returned on horseback with a single companion, making the whole trip to and from within the period of fifty days. He proved himself a hardy fellow, and showed what man can accomplish when the will is strong. In company with Lieutenant Lyon I then visited the Pend d'Oreille mission, to procure fresh vegetables for my men who already were affected with symptoms of scurvy. We had at this time about twenty-five cases of this disease, all of which readily yielded under the care of my brother, Dr. James A. Mullan, to the specifics of fresh vegetables and vinegar.

This fact was developed with regard to the scurvy: that among the citizen employés who received five days fresh beef and two days dessicated vegetables out of the seven, not a single symptom appeared, every case being confined to the soldiers who received but two days fresh beef and two days dessicated vegetables in the seven. The rations of the latter were regulated by Lieutenant White; those of the former by myself.

In our trip to the mission we made the distance from the Bitter Root ferry to the Bitter Root valley in February and March without difficulty or detention. We carried with us a small quantity of forage, to be used in case of emergency; but we found grass at every camp. The ground, in places, was still covered with snow, but here and there large tracts of prairie were found covered with abundant grass; the smaller creeks were still locked in ice, but the main Bitter Root river was open and free.

Accomplishing the object of my journey, I returned to camp in the latter part of March to find my work progressing satisfactorily. As before stated, the timbered section of fifteen miles from our camp to the ferry was kept in abeyance until the disappearance of the snow should enable the ground to be worked; hence all the parties were engaged along the right bank of the Bitter Root river. The topographical character of this stream required us to keep along its right bank for a distance of thirty miles at least, and whether from this point a change to the opposite bank would be advisable, to avoid long ranges of difficult spurs, forming bluff banks for seven miles, could only be determined by thorough detailed examination The fluviatile plateaus that mark both banks afforded us an excellent location; they are of different levels, but generally from fifty to twenty feet above the water, from one-fourth to two miles broad, covered with pines, without underbrush, and well grassed. The work in this stretch of thirty miles involved three miles of excavation.

Mr. Sohon, in his examination of the previous year, brought to my notice that the spur of the mountains thirty miles from the ferry jutted upon the river bank for six miles, leaving no berme over which we could lay our road. This would force us either to cross the stream, make a side-hill cut through this length, or turn the mountain by its rear. I endeavored to accomplish the latter, and in the month of April devoted several days to examining the entire country, and especially a route known as Brown's Cut-off; but I found the mountains so high and abrupt, to say nothing of the snow, that I gave up all hopes of attaining my ends in this direction.

To make this six-mile cut through rocky spurs was an undertaking that I almost feared to attempt. I fully appreciated the advantages of a continuous stretch along one bank; but the extensive plateaus on the opposite side formed so inviting a contrast to the rocks and bluffs before us, that I at first allowed my judgment to decide in favor of the additional crossing, and, indeed, had begun to get out the material for a flatboat, when, reflecting on the many contingencies to which these boats would be subject from fires, floods, and Indians, I re-examined these spurs, and determined, at all hazards, to make the cut, thus having but one ferry on the river.

The road from our winter camp to the Big mountain, as these spurs are called, was completed by the 10th of May, including the fifteen miles of heavy timber already referred to, which was opened by Lieutenant White and Captain Delacy. On the 1st of May I commenced upon the cut around the Big mountain, and by the 10th had my entire force of citizens and soldiers employed. My camps were formed at its west base, where a small creek and an abundance of timber afforded all the conveniences required. In order to obtain the practicable elevation, on account of the abrupt, rocky faces of the spurs, I carried the line up a ravine, until, gaining 1,000 feet, I wound around the mountain sides, making the re-entering angles by gentle curves, until the entire six miles was completed. It was a severe piece of work, and cost us the labor of 150 men for six weeks. Being rocky in most places, we were compelled to blast, when, by a premature explosion, one of our men, Sheridan, lost one of his eyes, and another, Robert P. Booth, was severely stunned; this finished, all further difficulties as to location ceased.

In the remaining stretch to Hell's Gate, amounting to sixty miles, we made one and a half mile of side-hill excavation, built a bridge of 150 feet in length, over a bad slough seven feet deep, and continued the road through much open timber. This line, during this season, was left in fair order. Our entire work to the Hell's Gate ronde was completed by the 28th of June, when our train was moved from our winter camp to the residence of a Frenchman, named Brown, where I had built a storehouse to leave such supplies as I did not care to transport to Fort Benton. While my train was encamped on the left bank of the Bitter Root the river gained its maximum rise, and during the night swept away our ferry-boat, leaving us no alternative but to build another. The men therefore were set to work to whipsaw the necessary lumber, built and launched the boat, crossed the train and set it in motion on the other side—all within seven days.

The 90 miles from the Bitter Root ferry to the Hell's Gate ronde affords a good road, with camp grounds at convenient points, with an abundance of wood, water, and grass. Many beautifully situated agricultural tracts are found through this region. The principal of these are the Nine-Mile prairie, the Nemoté prairie, the Skiotay and Kul Kullow creeks, and several stretches of great extent along the main Bitter Root river. Game is in abundance in the shape of deer and sheep, and all the streams are filled with trout. My astronomical party was moved to the Hell's Gate ronde on the 1st of April, which point it occupied until the middle of May, when it was sent to Fort Benton, *via* the Big Blackfoot Pass; it was deemed best to send it to Fort Benton at once, and let it take observations there during the remainder of May and June, as the atmosphere in the prairies was then clear, and to return to the summit of the Rocky Mountains at Mullan's Pass in July, when we could take the necessary observations for determining its position, and also observe the eclipse of the 17th of July, 1860, and thus determine the longitude.

In order to get the geographical connexion of the Bitter Root with the Clark's Fork, never before made, I sent out Captain Delacey with a boat party. It was satisfactorily obtained, and a map of both rivers made. His detailed report is appended.

Having now completed all the work of exploration and construction to the west of the Hell's Gate ronde, we pushed on to the Blackfoot river, and reached our crossing point on the 1st of July. I here detached a party under Mr. Howard and Mr. Kolecki, to make a thorough examination of the Big Blackfoot and run a line of levels from the mouth of its tributary, Lander's Fork, across the Rocky Mountains, *via* either Cadottes or Lewis and Clark's Fork Pass to the Dearborn river. According as a preliminary examination should best determine, this party was to join my own at the crossing of the Dearborn river.

This work was accomplished, a profile determined, and many valuable statistics gained, which will be hereafter referred to in detail in the chapter on "railroad data." Mr. Kolecki's more detailed report is herewith appended.

Reaching the Big Blackfoot, we crossed to its left bank on the 1st and 2d by means of a wagon-boat and a small bateau, transported for the purpose. We carried this last the entire distance to Fort Benton, and in it Mr. Williamson with a small party descended the Missouri to Fort Randall. While crossing this river we learned of the arrival at Fort Benton of Major Blake, with a command of three hundred recruits *en route* for Fort Walla-Walla, and who awaited our arrival at Fort Benton, to supply himself with the necessary means of transportation. This movement was the execution of the recommendation to which reference has been made. Our location up the Hell's Gate this season involved eleven crossings of this stream in fifty miles; the first was ferried, the rest forded. This stream is from one hundred and fifty to two hundred and fifty feet broad; its current rapid, and its course very serpentine over the distance that we followed it. Its valley is from one to four miles broad, and mostly timbered with open pine. The location, until reaching the last crossing of this stream, was one not involving much labor, being simply slight cutting in timber, grading banks at river crossings, and such other light work *en route* as the face of the country called for. We reached no point of much difficulty until making the eleventh crossing of the Hell's Gate, where a spur involved a cutting of half a mile to enable us to pass it. This was completed by the 9th of July, when with rapid marches we hurried forward to the mouth of Gold creek. On our march to Fort Benton this season we made the mouth of the Little Blackfoot a point of the route; this involved three additional crossings of the Hell's Gate, and four of the Little Blackfoot, all of which we avoided on our return trip.

From the eleventh crossing of the river, now the only one bridged, the Hell's Gate widens to a broad valley, the spurs recede and large flats or plains are found; it has many rich and fertile spots, and the river has many tributaries; the valley generally afforded an excellent location for our road.

From the mouth of the Little Blackfoot the stream makes an elbow to the north for a distance of ten miles, and to avoid this bend we crossed the open prairie in the re-entering angle, and struck the river again near Belknap's camp. This section involved light work. We then followed the stream until it forked and took up the north branch, making two crossings of the main river, and a greater number of its north fork.

The chief difficulty up this fork arose from its wet and mucky condition, which continued for eighteen miles, when we reached a gravel formation.

The valley of the Little Blackfoot and its north fork is from one-fourth to two miles broad, bordered by timbered spurs of one thousand feet. The soil in places is a rich black loam; but its altitude above the sea may prevent its ever being brought under cultivation; with the necessary work that this section involved we reached the west base of the Rocky Mountains by July 16. On the morning of the 17th we crossed the range at Mullan's Pass without difficulty, and encamped upon the waters of the Missouri. You approach and descend this pass by a gradual slope; its summit is not timbered; the mountains on both sides are much higher and densely timbered with fir and pine. It is six thousand feet above the level of the sea, and is evidently one of the lowest depressions in the whole range. The pass at the head of the south fork of the Little Blackfoot is practicable for a wagon road, but its position was too much out of the line of our connexions to answer our purposes; it may, however, come into requisition if ever a connexion from the Deer Lodge valley to the plains of the Yellowstone is determined upon.

The eclipse of the sun occurred at an early hour on the morning of the 17th of July, but as our astronomical party had now descended the Missouri for St. Louis we were deprived of the opportunity of observing it from the summit of the Rocky Mountains, as originally contemplated. More detailed allusion will be made to this mishap in the astronomical chapter that is subjoined.

Crossing the Rocky Mountain range at Mullan's Pass and descending upon the Missouri slopes, a new climate and new character of country is at once encountered. The spurs of the mountains become lower and less timbered, the country more diversified with hill and dale, and the scope for a wagon-road location enlarged. The climate, too, is warmer, the frosts at night less severe, and the great difference of heat between midday and midnight no longer noticeable.

The first stream touched upon the eastern slope is the Big Prickly Pear creek. It rises at the foot of the pass, and, draining a region twenty miles in width, empties into the Missouri. Its valley for two miles partakes of a cañon-like character, where, however, with moderate work, we secured a good location; at the end of this the valley widens, until, near its junction with the Missouri, it has become a prairie ten by fifteen miles in extent. Many fine, though small tracts of tillable land are found within it, and, at present, game abounds. Once in the valley of the Big Prickly Pear we had made our extreme point of southing, and were enabled to turn all the eastern spurs and take a direct line for Fort Benton.

Our location involved three crossings of the Big Prickly Pear, making which, on the morning of the 18th of July, we left its valley and moved northeasterly over rolling hills until we reached and encamped upon Fir creek, distance four miles. In this stretch only light work was required.

The plateau of the Fir creek is about forty feet above its bed, to descend into which required a side cut of sixty feet, and a bridge of thirty feet; making these, on the morning of the 19th of July, we again moved over a rolling prairie region, and in five miles reached and encamped upon the Silver creek. We had now left the more difficult sections of the mountains, and skirted along their eastern bases over the long lateral spurs making out from the main range; these spurs were untimbered, and here became reduced to easy rolling hills; only light work was needed in this last section, so that, on the 20th of July, we again moved forward, and in five miles reached the Soft Bed creek, crossing in the interval the Willow creek; this last unites with the Silver creek, which, with the Fir creek, become tributaries of the Big Prickly Pear. None of these streams interpose obstacles to travel, except during the higher freshets, and then only for a few days. The Soft Bed creek is a stream of inconsiderable extent, rising in the prairie hills, and flowing into the Little Prickly Pear. This last rises in the main chain of the Rocky Mountains, and flows through a cañon, with intervals of bottoms, until within three miles of the Missouri, when the hills that bound it recede, giving its valley a width of three miles. It drains a considerable extent of country, and in this vicinity is one of the larger tributaries of the Missouri.

Along the Soft Bed creek but slight work was required to secure a good road; so that, on the morning of the 31st of July, following up this creek to the hills in which it rises, we crossed these hills with moderate work, and at once fell upon another tributary of the Small Prickly Pear, which we called Hard Bed creek. This contains water only a portion of the year; its valley is from a fourth to a half mile in width, bounded by low timbered spurs, and is about eight miles long. We now entered upon the red sandstone and slate formation, the country generally giving every indication of the presence of gold; we followed this stream to its junction with the Small Prickly Pear, which last we crossed, and now entered upon the last point of material difficulty before reaching Fort Benton. The junction of the Hard Bed creek with the Little Prickly Pear affords one of those prairie intervals before referred to, which, at this point, is one by three miles in extent; at the eastern limit of this prairie the Little Prickly Pear again enters a deep rocky cañon, a perfect defile, leaving no berme on its either side. This difficulty drove us over a broken section, which we termed Medicine Rock mountain, and where we worked the road for four days. Its peculiar features of difficulty, and the short time allowed us in which to reach Fort Benton, where Major Blake awaited us with much impatience, all determined me to secure the cheapest and most rapid location; and, for this reason, after descending once more into the valley of this stream I made eighteen crossings, and again reached its more open valley within three miles of the Missouri river. This last was the nearest point of our road to the Missouri, until we reached it at Fort Benton.

On the Medicine Rock mountains we found traces of quartz, and continual indications of gold; one of my men found ten cent prospects in the Big Prickly Pear at the point where it enters the rocky defile referred to, and the Indians gave me to understand that two miles higher up the stream, in another cañon, gold had been found by them. The Medicine Rock section was by far the most difficult of any point along the entire line, from Hell's Gate to Fort Benton, and to it attention will again be given.

Completing this work by the 22d of July, we again moved forward over prairie hills for nineteen miles, when we reached the Dearborn river. We now left both the mountains and their spurs behind us, and emerged upon the broad, swelling prairies of the upper Missouri.

The Dearborn river rises in the main chain of the Rocky Mountains, and for six or eight miles winds through a deep sandstone gorge, when its hills gradually recede, giving place to prairie bottoms covered with cottonwood. Its stream is two hundred feet broad, and fordable, except during the freshet, at which period it is subject to rises that flood its banks and sweep everything before it. The party under Mr. Kolecki, sent to explore the valley of the Big Blackfoot, rejoined us here.

While encamped upon the banks of the Dearborn we were overtaken by Mr. W. W. Johnson, direct from Washington, with despatches, setting forth a continuation of our appropriation, and orders countermanding instructions that had been issued relative to my command, and the action taken by Major Blake in regard to the same.

From the Dearborn, on the morning of the 27th of July, we travelled over an easy prairie region to a camp at the Bird Tail Rock, passing along the Beaver creek for three miles, and finding during this length an excellent location, requiring but little work. From thence, on the 28th, we proceeded to Sun river, crossing the same at a ford where is situated the Indian agency of the Blackfeet, then in charge of Colonel A. J. Vaughn.

At this point our work proper ceased, for the remaining distance of fifty-five miles to Fort Benton was over an easy and almost level prairie road, with no running streams. The prairie is thirteen hundred feet above the Missouri at the fort, and broken at its southern edge by deep coulées and ravines making into the river, and on its northern edge by similar formations making into the Teton river. A knowledge of the topographical face of this country would therefore show that a feasible line would lie over the high table land and between the heads of the coulées, on its either side, provided water was supplied. This is afforded by a lake sixteen miles to the eastward of the Sun river, and by springs seven miles to the east of the lake. These points subdivided the distance of fifty-five miles from the Sun river to Fort Benton into convenient day's marches. It will be readily seen that the character of the region immediately bordering the Missouri and Teton rivers precludes the possibility of carrying a road by either of these sections.

On the morning of the 29th of July, leaving a portion of my escort in camp on the Sun river to await my return, I divided the remainder of my party into four portions, each to proceed to Fort Benton by different routes; one to camp at the lake, one at the spring, the third to proceed to the Teton direct, and the last to move up the Sun river to the Old Blackfoot mission, striking thence across to the Teton, and down it to Fort Benton. This was done for the purpose of examining the country, as well as to bring in a report of each route, which would enable me to judge which was the proper location for a permanent line. When the different reports were presented, I found that the one *via* the lake, the spring, and thence to the fort, possessed advantages over all the rest, and was consequently the one chosen for the permanent road.

The Sun river rises in the main chain of the Rocky Mountains, in latitude 48°, and empties into the Missouri about nine miles above the falls. Its border is fringed with cottonwood, and its valley is from one to three miles broad, possessing many tracts of arable land. The Blackfoot agency has large fields under cultivation, where wheat, oats, and every character of vegetable is raised. There are many beautiful agricultural tracts to the south of the Bird Tail Rock, along the many little creeks that rise in the broken section lying between it and the Missouri. Fuel is abundant, though timber for building purposes is scarce. Our different parties that left the Sun river on the 29th of July all reached Fort Benton by the 1st of August. Here we found Major Blake encamped, with three hundred recruits, awaiting our arrival. We remained her until the 5th of August. A Mackinac boat was built for a party to descend the Missouri to St. Louis, composed of discharged civilians and such soldiers as were near the expiration of their term of service, all under charge of Lieutenant J. L. White. This party made the trip without accident, and for a portion of the distance in company with one of the boats of Captain Raynolds, of the topograghical engineers, who for three years had been exploring the country from Fort Laramie to the head waters of the Yellowstone and Missouri, and who had reached Fort Benton only two weeks in advance of our own party. The arrival of Captain Raynolds was of advantage to ourselves, as he was enabled to add to our transportation a large number of pack animals.

Every available means of transportation being turned over to Major Blake for the use of his command, and having completed all the arrangements that our mission called for, we left Fort Benton on the morning of the 5th of August, on our return to Fort Walla-Walla.

At Fort Benton Mr. Sohon was transferred to Major Blake. as a guide and interpreter to his command; Mr. Creighton, one of our wagonmasters, was also transferred, and to their joint good services Major Blake was largely indebted for the success of his march. Such other of my men as could be spared were also turned over to him, so that, so far as our means could supply him, he had nothing of which to complain.

My plan in returning was to pass rapidly over the line, keeping always in advance of the major, and making such repairs as the condition of the road called for and as time allowed. Having turned over to Major Blake's command every wagon taken by us to Fort Benton, and using pack animals ourselves, we were enabled to make excellent time till reaching the Hell's Gate valley, where, having left a few wagons, we were enabled to put our pack animals into harness and used wagon transportation for the remainder of the distance. Our work in returning was limited to repairing the road, excepting at points more especially referred to hereafter. We made no radical change in the location, except in passing from Belknap's camp to the Deer Lodge valley.

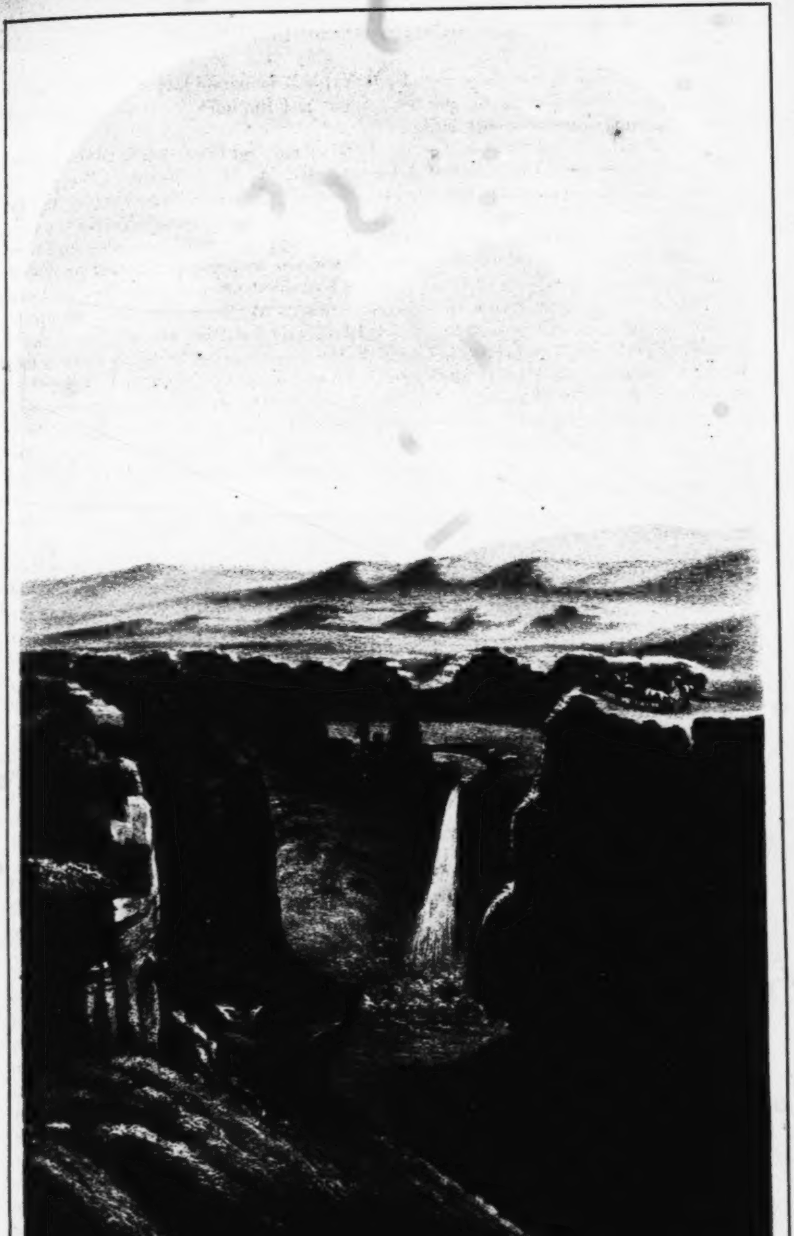
Having sent forward my wagonmaster, Mr. Caldwell, to examine this section, and it being pronounced by him practicable for wagons with a moderate amount of work, I determined to adopt it, and thus avoid the three last crossings of Hell's Gate and the four of the Little Blackfoot. It rendered the road longer by three miles; but the avoiding of these streams at high water was an object of great importance, and this is at present the permanent location of the road; thence to the Bitter Root ferry our movements were rapid and our work light. Entering the timbered region of the Bitter Root mountains, where the more difficult section of the road lies, repairs became more frequently necessary; we had originally cut the stumps as close to the ground as possible, but the road having been travelled, the melting snows of the past winter had washed away the soil from the roots, causing them, from their height, to constitute material obstacles. It was, of course, impossible to cut them down again this season, and hence, determining to make this a special work for the next summer, I limited myself to making such repairs as immediate necessity called for.

My health during this time had seriously failed me, and I had to intrust the general charge of the work to Lieutenant Lyon and Mr. W. W. Johnson. We pushed forward with the repairs until reaching the Cœur d'Aléne mission, where we arrived on the 1st of September. During this period of the march many despatches were sent back to Major Blake, advising him what camping points to make, and to so divide the distance as to facilitate his movements in passing the belt of timber.

On reaching the Cœur d'Aléne mission I divided my party into two portions, one under Lieutenant Lyon, to proceed towards Walla-Walla, keeping up the repairs of the road in advance of Major Blake and awaiting me on the banks of the Touchet river, employing his men in the meantime in building there a new bridge; with the other party under my own supervision, I returned to the third crossing of the Cœur d'Aléne, to there erect a pier in the middle of the stream, with a view of testing the force of the current and obtaining in the spring fixed facts regarding the rise of the water, as these would be of value in preparing the general programme of my next season's operations, which I intended to lay before the department.

This was done: a triangular pyramid of fir logs twenty-seven feet long, twelve feet broad and ten feet high was erected, with a floor fitted with rock, and left until the following spring. My party, on completing this, resumed the march towards Walla-Walla, reaching the advance camp on the Touchet by the last of September. Here, uniting our forces, the bridge, except its covering, was finished in a few days, the hewn pine timber for its construction being hauled twelve miles, as nothing but cottonwood was found nearer its site. Completing this structure, we reached Fort Walla-Walla in two marches, where, discharging my men and returning my escort to the companies to which they belonged, I brought to a conclusion a long and tedious work constituting my second expedition. The command of Major Blake had made the trip without accident in fifty-seven days, and were now encamped at Fort Walla-Walla; on reaching the Cœur d'Aléne mission they had been met by a pack train from Fort Colville, and by that means turned over one hundred and fifty recruits to the companies there stationed; another portion was turned over at Walla-Walla, while the remainder proceeded to the Dalles and Fort Vancouver. Thus ended this military experiment *via* the upper Missouri and Columbia rivers; and the success that attended it, the good effects that it induced, the economy resulting, and the eulogistic manner in which each officer of the command referred to the trip, all constitute a sufficient commentary upon its feasibility for future military movements towards the north Pacific.

On reaching Fort Benton I had sent Mr. Kolecki to Washington with my field and note books, giving him instructions to commence the compilation of our maps. My instructions for the winter contemplated my compiling certain maps at Walla-Walla, but, as the note books necessary for the purpose had been sent off, I was left comparatively idle. The instructions from the War Department required that I should lay before them a plan of operations for the next season's work. Accordingly I prepared one that looked toward resuming work from the Pacific slope, and sent it to the department; but, on comparing a table of statistics of cost of labor and material on the Pacific with a similar table for the Missouri, I became convinced that the latter was the more judicious. My second programme looked toward outfitting at Fort Leavenworth, and proceeding *via* Fort Laramie to the Deer Lodge valley, where I should spend the winter of 1861, and then press the work vigorously toward Walla-Walla, reaching there by the winter of 1862. This would also enable me to test the value of the Laramie and Deer Lodge route, which had always been with me a favorite measure, give me two long working seasons, and subserve all the requisites of



Drawn by C Sohon

Bowen & Co lith Phil

PALOOSE FALLS IN WASHINGTON TERRITORY.

economy and efficiency. To carry out the plan I proceeded to Washington in the stage from San Francisco to St. Louis, *via* the southern overland route, and laid my views before the department. On my arrival in Washington I found affairs in a somewhat chaotic state, a change of administration at hand, my first project already indorsed and returned to me, and seeing so many difficulties interpose, I was forced to relinquish my Laramie scheme and proceed back to Walla-Walla, reaching there early in April. Immediately organizing my expedition, I was ready to proceed again to the mountains by the 13th of May, 1861. An escort of one hundred men from the 9th infantry was detailed to accompany my command, with Lieutenants Wickliffe and Marsh, and Dr. Lewis Taylor. The former soon resigned his commission and the latter exchanged places with Dr. George Hammond, United States army.

The change that had been wrought by the settlement of the country since the date of my second expedition compelled me to modify that portion of the road from Walla-Walla to the Snake river by changing the crossing point of that stream from the mouth of the Toukanon to the mouth of the Palouse. At the latter point a ferry had been established, chartered by the legislature of Washington Territory, to meet the wants of the Colville travel.

Making the mouth of the Palouse a point of my route likewise enabled me to avoid all the crossings of that stream. The bridge across the Touchet and Dry creek were now completed, and, with the road thoroughly worked from the former to the Snake, left this stretch of forty miles in good order. The distance from the Touchet to the Snake river is twenty-seven miles, with springs seven miles north of the former, and the remaining portion of twenty miles is the longest section without water on the whole route.

From what I had seen of the wet and mucky character of the St. Joseph's valley in early spring, I found that we should be compelled this season to cross the Spokane river and skirt the northern rim of the Cœur d'Alène lake, opening a new section of thirty miles from the lake to the mission. To this end I had the line explored in September, 1861, by Mr. W. W. Johnson, whose report is herewith appended. This latter, though not furnishing the minutiæ that the location afterwards demanded, tended at least to give me general facts to guide my judgment.

Crossing the Snake by the 20th of May, we worked the road up the bluffs on its right bank and gained the table land, when we had no difficulty in making a camp on the Palouse, fourteen miles from the former river. I availed myself at this time to make a visit to the falls of the Palouse, which are situated nine miles above its mouth. During a high stage of water they form beautiful and interesting falls. The whole river, which for a mile or more has been confined to a narrow cañon, here leaps in a single sheet over a rocky ledge into an octagonal basin one hundred feet below. The sides of this basin are perfectly black, and the belt of foam, with the spray and mist rising from its base, renders the whole a picturesque scene well worthy a visit. There are other lesser falls above, but none worthy particular mention. Mr. Sohon has made a very truthful sketch of the larger. Occurring, as they do, in a most uninteresting region, with no signs of habitation or life to break the dreary silence of travel, they serve in a most pleasing manner to break the monotony of this desolate waste.

Leaving the Palouse on the morning of the 21st of May, we journeyed over the prairie hills to Cow creek, a distance of eleven miles, having an excellent road. The Colville wagon road from Walla-Walla is one and the same with our own up to this point; thence it tends up the Cow creek, while our own leads towards the east in the direction of Antoine Plant's ferry on the Spokane. This ferry is chartered by the legislature of Washington Territory, and, being already established by a fixed settler, I determined to make it a point of my route.

Leaving the Cow creek on the morning of the 22d of May, we moved 18 miles over an easy, open prairie country, with light work, to Aspen Grove;

springs of water were passed en route. From thence our next march was to a chain of lagoons, distant 2½ miles, for which distance we still had an excellent prairie road; and from thence to Rock creek, crossing it at the same point made by our old location. Rock creek rises in the Spokane plains, and flowing mostly through a basalt and red sandstone formation, unites with other small streams, and pours its tribute into the Palouse river. There is no country for settlement immediately on this creek, but back a mile or so small patches of arable land exist; this entire district is a pine timbered plain, the timber being in strips of from one to six miles broad, and extending from the Spokane as far south as the Palouse, near the Mocahlissia. From Rock creek, in 13½ miles, we reached Lake Williamson, a beautiful sheet of water in spring, but which evaporates by early autumn. It receives the drainage of a large portion of the Spokane plain, and is surrounded by a fine growth of pine; bordering its margin we also find an excellent tract of fertile soil. Water can be obtained from springs that exist in the neighborhood at all seasons, and there is a smaller lake a mile to the westward, where it may always be had.

From Lake Williamson, in six miles, we reached Hangman's creek, the valley of which is four hundred feet below the Spokane plain; this involved a cut of one-third of a mile, at the end of which we reached the point selected for a crossing. This stream was now swollen, and we camped upon it four days, while building a bridge fifty feet long. Having improved the road in advance, we moved on towards the Spokane at Antoine Plant's, reaching that point on the 1st of June, a distance of 12½ miles from Fort Walla-Walla; at this point we were joined by another portion of the escort, which had marched from Fort Colville under Lieutenant Harker of the 9th infantry; these fully completed the complement of men originally intended for the expedition.

The ferry at the Spokane is a good one, consisting of a strong cable stretched across the river, and a boat forty feet long; it is kept by a very worthy man, Antoine Plant, a half-breed Flathead Indian, who speaks both French and English; he has a small field under cultivation on the left bank, near the ferry landing, from which he obtains corn, wheat, and vegetables; these, with the salmon found in the river, form an abundant supply for his Indian family. The winters here are generally mild, and stock range the hills and plains the whole season, no provision for forage being made. Small tracts of good soil are found bordering the river, as well as two or three miles back; several of these are under cultivation by the Indians, and a few Frenchmen; one of the finest of these is on the south bank, about ten miles from Antoine's, in a re-entering angle of the mountains; here the Cœur d'Aléne Indians have small farms enclosed. This latter region is said to be one of the mildest sections in the Spokane country; little snow falls, and it is protected by long spurs of mountains; these advantages, together with running brooks and perennial springs, will render it a choice locality as the country becomes settled.

Effecting safely the crossing of the Spokane river, which is here three hundred feet broad and eight deep, with rapid current and high banks, on the morning of the 3d of June we moved up its right bank to a camp at Seltisse's farm, distant nineteen miles. We had an excellent road, fifteen miles of which was over level prairie, and the remainder through a beautiful open pine forest; work in clearing away the fallen timber was all that was required. We passed, during this march, an Indian burial ground of the Cœur d'Alénes, where a cross, erected over each grave, testified to the cheering fruits of the labors of the noble Jesuit fathers in their midst. Seltisse is a worthy Cœur d'Aléne Indian, who has several acres under cultivation, and with hunting, fishing, and tilling the soil, leads the life of an independent chief; I have always found him frank, honest, and friendly.

From his farm we reached in four miles a considerable creek that drains a small sheet of water to the north, and empties into the Cœur d'Aléne lake;

here we entered a difficult belt of timber, extending for thirty miles to the Cœur d'Aléne mission. I determined, therefore, to make this a depot point for such provisions as we had with us, and send a wagon train back to the mouth of the Palouse, where the steamers were to deposit the remainder. Perfecting these arrangements, I set my men at work—a portion building a bridge over the stream, and the remainder making a side cut in the spurs that jutted upon the lake. Mr. Sohon, with a small party and an Indian guide, was kept in advance to mark out the road, and give us, in full detail, the features of the country. This thirty miles of new road was a difficult undertaking, and occupied us until the first of August. The country was broken, and unfavorable to our purposes, but we took advantage of its features as far as possible, following the bottoms of small creeks, and only cutting through the dense timber when it could not be avoided; by these means eventually securing a fair location. The Wolf's Lodge prairie, with an area of a mile square, occurs midway between the mission and the lake, and, with the fine grasses on the hills that surround it, constitutes a fixed and favorable camping ground. Traces of gold are said to have been found in it; and I had myself come across a small camp of men here on my return from the mission in 1862. Quartz is found on many of the neighboring hills, and rumor would set forth that this immediate section was favorable for gold developments. Reaching the Cœur d'Aléne mission, we united with our old road of 1859.

Having abandoned the St. Joseph location, I sent a party to remove the ferry-boat from that river to the Cœur d'Aléne, at its first crossing. My work from this point forward during the first season was to improve the road by cutting the stumps close to the ground, avoiding as many crossings of the Cœur d'Aléne and St. Regis Borgia rivers as possible, by side cuts along the mountains, and by bridging those I could not avoid, and, finally, to select a mild and sheltered point for passing the winter. With these objects in view, my entire force was divided into sections of from four to twenty men, with a chief. Each being assigned a bridge to build and the road between two crossings to repair. To each was given wagons drawn by oxen for hauling the heavy timbers, and having blocks and tackles to assist. With these arrangements we made light work of the bridging. All spans over fifty feet required piers, which were filled with rock from the bed of the stream. As soon as one bridge was finished the party in charge would move forward to another. The bridge and abutment sites were all selected by myself, and this system was kept up until the whole was completed. The timber used was red fir and white pine for the framework, and red and white cedar and red fir for covering. We continued bridging the crossings of the Cœur d'Aléne until we reached its forks, when the stream, becoming smaller, no longer absolutely demanded it; but the route would be improved by having every crossing of the north fork bridged. We built twenty heavy bridges on this river, which, together with the repairs in its valley, occupied us until the 15th of September, when, crossing the summit of the Bitter Root mountains, we reached the head sources of the St. Regis Borgia river, on which a similar system was initiated.

The lateness of the season and the magnitude of the work, however, all warned me to modify my plan by limiting myself to erecting the frame work of the bridges, and leaving the covering for another season. This was done, and the work pushed forward to completion by the first of November, when the snows of the mountains obliged us to leave for a milder region, for I felt no inclination to again risk the disasters and losses of the previous winter.

During this time my supplies had been thrown in advance to the Bitter Root ferry, where our depot was established. A portion of my escort, with its train, also went to the junction of the Hell's Gate and Blackfoot rivers, under Lieutenant Marsh, that point having been selected as the site of our winter camps, where he was to erect the necessary log-houses. I was governed in this selection by the fact that the Big Blackfoot was here to be bridged, and my remaining work for the winter and spring lay beyond, along the valley of the Hell's Gate; its proximity to our grazing camps was also a matter of much moment.

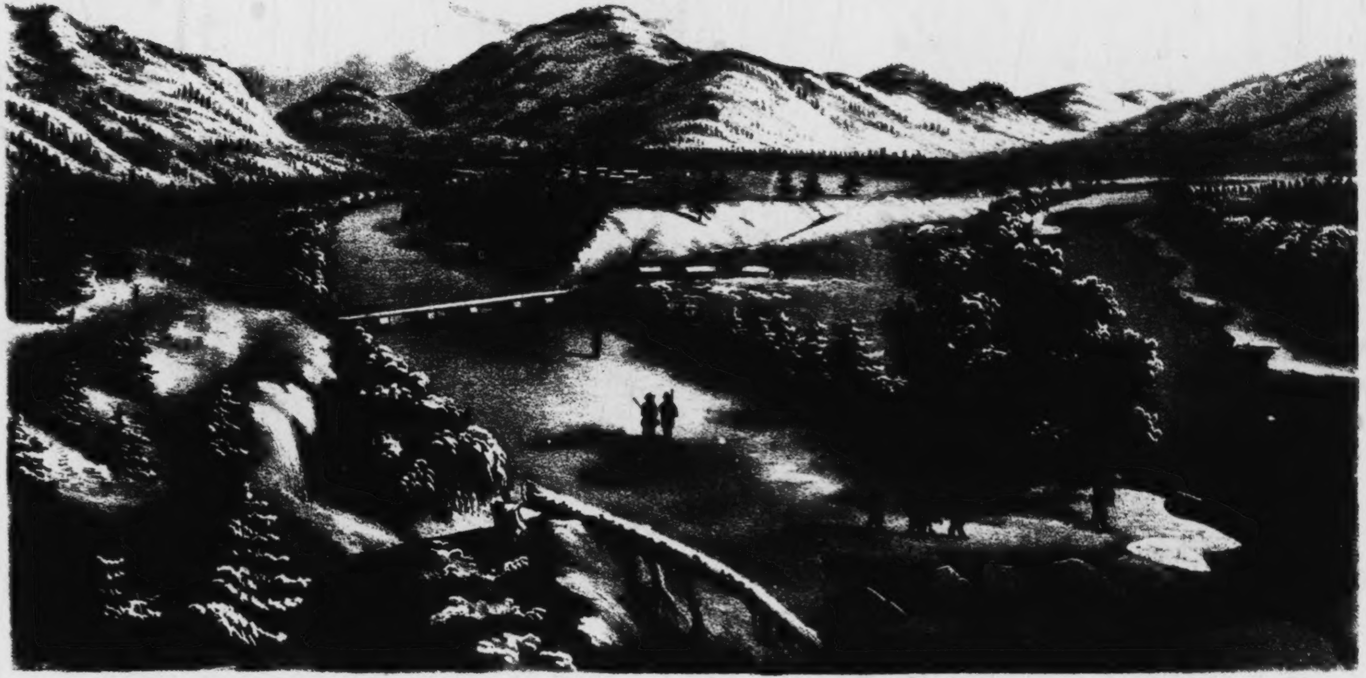
Completing the entire work of the Bitter Root crossing we rendezvoused at this point on the 1st of November, and then moved along the right bank towards our winter camp. I employed the men en route in such labor as the condition of the road called for and the lateness of the season permitted. But few sections of the entire distance had become much out of repair and hence our movements were so rapid that we reached the Big Blackfoot by the 22d of November, but not before snow had covered the ground and floating ice showed the approach of winter. On reaching our winter camp the stock were driven to the sheltered valley of the Bitter Root and my entire force divided into five sections, one to build the bridge over the Blackfoot, and the others to be distributed in winter camps along the Hell's Gate at points where side cuts were to be made to avoid the crossings.

My programme of work from this point forward was to avoid all the crossings of the Hell's Gate except one, which would be bridged, and to put the road thence to Fort Benton in such repair as time and means warranted.

Each party was directed to build for itself log huts, and when these were completed to begin work upon the road. I was sanguine that I would be able to work during the winter months, except when the weather should prove of marked severity, and in this I was not seriously disappointed. The party remaining at the main camp having completed their huts began getting out the necessary timbers for the Big Blackfoot bridge. The stream had already become frozen at its edges; and when all the timbers were cut, hauled, hewn and ready to be put together, we threw a boom across the river, which here was two hundred and thirty-five feet broad, six feet deep, and had a current of four miles an hour. By means of this boom we dammed up the floating ice, which in a single night became sufficiently frozen to allow horses to cross. Taking advantage of this ice, we cut an opening large enough to hold the piers and commenced their construction, sinking them, by means of rock placed on a bottom, with which each was provided, until they rested on the river bed. They were levelled by making a profile of the bottom and adjusting blocks under the longer set of ties. Rock for filling them was gathered from a bluff at the abutment site on the left bank and by means of hand sleds run over the ice to the piers, which were thus rapidly filled. Each was thus built and the entire frame-work and superstructure erected before the ice broke up. While this was being done the whipsawyers were at work sawing out plank seventeen feet long and three inches thick for its crossing; and by the 1st of March we had completed the entire bridge, which was two hundred and thirty-five feet long, with four spans.

This work finished, every available working man was ordered from the main camp to the several outer camps to push forward these sections of the road. The winter had proved one of unusual and marked severity; the snow had fallen as early as the last of November, and continued on the ground as late as the middle of April, with intense cold for about two weeks in January. This compelled us to move our supplies on hand sleds from our main to our minor camps. For a short period in January all travel in the mountains was suspended and from cold and want of forage many of our animals died. The Indians had never before experienced so severe a winter and the poor creatures came in for their share of suffering and loss of stock. This range of cold extended as far east as Fort Benton, the furthest point from which we obtained any data and as far west as the coast. The losses sustained during the winter, together with losses from the heavy freshet that had preceded it, will long be remembered throughout the length of the Pacific coast.

I here mention with regret a sad accident that occurred to a citizen in passing



Drawn by C Sohon. Bowen & Co lith Philada

CANTONMENT WRIGHT,—CAPT. MULLAN'S WINTER QUARTERS IN 1861-2.

from one to another of our camps, and which will tend to show the degree of cold we experienced during January. He had left one of the camps with the intention of going to the Deer Lodge valley. Night and severe cold overtaking him before he could reach another camp, he halted to build a fire, and being wet endeavored to slip off his moccasins, when he found them frozen to his feet. He became alarmed, and retracing his steps reached the point he had started from, late at night, but with both feet frozen, and on their being thawed in a tub of water all the flesh fell off. The poor fellow suffered intensely, and his life was only saved by his suffering the amputation of both legs above the knees; the operation was performed by Dr. George Hammond, United States army. A purse of several hundred dollars was raised for him, and he was left to the kind charity of the fathers at the Pend d'Oreille mission, where he remained up to the date of our leaving the mountains.

Our force was now concentrated upon the side cuts along the Hell's Gate river. This work was finished by the middle of May, involving, in all the five cuts, seven miles of excavation, partly in rock. These cuts avoided ten crossings of the Hell's Gate river. At the distance of thirty miles from the Big Blackfoot we were compelled to throw the location to the left bank of the Hell's Gate, and this necessity involved a bridge of two hundred and fifty feet.

Finding, in the month of May, that the high water prevented me from building this bridge, I gave the contract for the same to a Mr. Samuel Hugo, a resident of the Deer Lodge valley. This is now completed. He was enabled to get out all the timber in high water, and erected it as the freshet subsided. The completion of this work left the entire line to the Deer Lodge valley in a practicable condition. Then my plan for a summer movement was determined upon.

Directing Captain Marsh and Mr. Williamson to break up our winter camp and proceed to the valley of the St. Regis Borgia and there cover all the bridges left unfinished during the past autumn, with an escort of sixteen soldiers and six civilians, and such of my employés as desired to return to the States *via* Fort Benton, I started for the Missouri river on the 23d of May, 1862. Cantonment Wright, so called in honor of General Wright, a warm friend of our enterprise, was now abandoned; though a cold and bleak place it nevertheless proved a suitable point for our purposes. The camp was situated upon the high flat in the forks of the Blackfoot and Hell's Gate rivers, where timber was abundant and close; but exposed to the bleak winds that at times came down the valley of the Blackfoot, it was found an abode of not over much comfort. All travel with the Indians had been suspended during the winter, but as snow disappeared they were once more on the move, some crossing the plains in quest of buffalo, whilst others were returning from the same point where they had passed the winter. The latter brought accounts of the severity of the winter on the upper Yellowstone and Missouri rivers, and of the loss of stock that nearly all the Indians had sustained.

Mr. Burr, however, in company with Mr. Worden, crossed the main range of the Rocky Mountains, in March, for Fort Benton, from which point Mr. Worden descended the Missouri to St Louis, to make his annual purchase of goods for his mountain trade. Though they found much snow in the mountains proper they found none on the plains; and during the month of April Mr. Dawson, in charge of Fort Benton, sent me a pack train across the mountains without difficulty or loss. It is but seldom that the winter is so severe as to interfere seriously with travel across *via* the Little Blackfoot and Deer Lodge prairies.

My arrangements for a departure from Fort Benton being completed by the 23d of May, we started with a pack train and made the Deer Lodge valley in five camps. Expecting to find the Flint creek much swollen, I had a canoe built and transported thither. This proved a most fortunate precaution, as on reaching its banks it was so much swollen that we would have been unable to make its passage without such aid. We halted at the American Fork and visited the Deer Lodge gold mines, where we found Messrs. Blake, McAdow, Higgins, Dr. Atkinson, and Gold Tom at work sluicing, and at that time they were taking out about ten dollars per day to the hand, and with fair prospects of extensive digging. Wherever parties had prospected in ravines or river bottoms they had found prospects from one to fifteen cents to the pan. Convincing ourselves by indubitable proofs of the existence of gold at this point, we continued our journey, reaching the fort without accident on the 8th of June. We had found the streams much swollen, especially the Little Blackfoot, Small Prickly Pear, and Sun rivers. We, however, forded them all, except the Sun. Fearing that the Dearborn would not prove fordable, I had sent forward a party to here construct a canoe, while with my whole camp I remained for two days at the east base of the Rocky Mountains, to there gain some additional data for determining the position of the pass. These data were collected by Mr. Kolecki, whose camp was pitched upon the summit of the mountains, and where most beautiful clear days and nights enabled us to obtain a good series of observations. Having had a ferry-boat built by Mr. Dawson, at the agency on Sun river, and which was kindly taken charge of by Mr. McCullough, we were enabled to cross this stream without very serious difficulty, though, at the time, the river was even with its banks and the current very rapid. For the want of other lumber the boat on the Sun river was built of cottonwood plank, forty-two feet long by twelve broad, and two deep.

Reaching Fort Benton by the 8th of June, we had a Mackinac boat built by the 12th, when my party started for St. Louis; and having myself completed all my business at this point, I started on my return to my party in the mountains. On the way back we had an abundance of game, for which we were largely indebted to Mr. F. H. Burr, who is an excellent shot and good hunter. Being desirous of recovering some horses stolen from him by the Blackfeet, two months previous, he had availed himself of our trip and became our compagnon du voyage.

On our trip from Deer Lodge to Fort Benton we performed no work beyond what our immediate wants demanded; but I was enabled to mark in detail the points where additional repairs were yet required. The chief point was over the Medicine Rock mountain. It is barely possible that the Medicine Rock mountain might be avoided by following down the Big Prickly Pear, immediately on crossing the Rocky Mountains to the Missouri, and working a road along that river to near the mouth of the Little Prickly Pear. I am not positive whether this can be done. I examined this section in 1854, and my recollection of the region was against its feasibility. In case the road should be reworked it is worthy a special examination. There is no other way of avoiding this mountain, and should this prove impracticable nothing is left except to work the high water trail throughout over the Medicine Rock mountain; this, in many places, will be through rock, but with time and means a good road can be made. After this a good bridge should be built over Willow creek; the two crossings of the Big Prickly Pear should be avoided by work over the hills, and the entire section along the north fork of the Little Blackfoot should be worked by excavating a road along the northern side hills, wherever the ground is wet and marshy. Two crossings of the main Little Blackfoot should be avoided, and a bridge built over its third and last crossing. With these improvements, and such other slight work as the nature of the repairs may demand, the road from Deer Lodge to Fort Benton will be an excellent one at all times, and upon which, in time, there will be much travel. I returned to the Deer Lodge valley, at the American Fork, by the 24th of June, meeting several wagon trains en route for Fort Benton, to freight out supplies for the Bitter Root and Deer Lodge valleys. At the American Fork I was overtaken by Mr. Steele, from Fort Benton, with the intelligence that four steamers had arrived at that point since the date of my departure, with three hundred and sixty-four emigrants from St. Louis, for Walla-Walla and other points en route; that they were provided with saw and grist mills, and that there were among them many miners who intended prospecting the country en route; also, that another trading house, under the auspices of La Barges, Harkness & Co., of St. Louis, was to be established near Fort Benton. This cheering intelligence was very gratifying to myself, seeing in it the commencement of a long line of emigrant travel, that in years to come must course along these rivers in search of new homes towards the Pacific slope.

Learning at American Fork that Captain Marsh was pushing on towards Walla-Walla, without having done what had been contemplated by myself, on leaving Cantonment Wright I left my party under charge of Mr. Sohon, with instructions to move at easy marches till overtaking me, and with one man moved rapidly to the camp of my advance party, then under Mr. Williamson, reaching them July 1st. Finding Captain Marsh had already crossed the Spokane, and being so fatigued by my long journey as to be unable to proceed myself, I despatched one of my men with orders to Captain Marsh to halt and await further instructions, and at the same time forwarded despatches to Generals Wright and Alvord reporting the same.

Captain Marsh afterwards returned to the Spokane, and there, awaiting the arrival of myself and party, stated to me that he had misunderstood the exact instructions given him, so no further action was taken in the case. To me it was a source of regret, and militated strongly against the best interests of the road, and the amount of work which might have been judiciously performed in replacing certain bridges that the freshet had destroyed, and aiding Mr. Williamson in his severe work of covering others. I found, on my return, that one of the sections along the Hell's Gate had been washed away by the sudden rise, and the Big Blackfoot bridge, to a certain extent, thrown out of shape. The latter I gave to Mr. Hugo to repair, and with regard to the former, I told the county commissioners of Missoula county that if they would have this section repaired I would recommend that the sum of $500 be set aside to cover its expense. With these two exceptions no additional repairs were needed till reaching the Sciotay creek. Here a bridge should be erected, and the present upper crossing might be found the best place for locating it. The Rocky Points, several miles below, might be either repaired or changed to the trail line, and here blasting or bridging might meet all the difficulty of location. No other material points need attention until we come to the Nemoté creek. Here, instead of taking Brown's Cut-off, I should now prefer to excavate a line from one and a half to two miles along the Bitter Root, and say, from one hundred to two hundred feet above the river, in order to get above all the slides, and by this means shorten the road two miles and avoid a steep hill. This done, there would be no further work required till reaching the Bitter Root ferry. From this point to the Spokane plain, a distance of one hundred and twenty miles, I should desire to see the timbered section cut 60 feet broad. The admission of additional sunlight, and heat, and the less danger of obstruction from fallen timber, as well as the greater rapidity with which the snow would melt in autumn and early spring, are advantages in its favor so strong that if done at least two months of travel will be added yearly, and the road made subservient to many more objects than I can now claim for it.

A road should be cut around Mud prairie to its south, and thus avoid a point difficult in early spring. We lost six bridges along the St. Regis Borgia and two along the Cœur d'Aléne, during the freshet. Four of these might be avoided by a side hill excation another season, and it should be worked at any cost of construction; the excavation will be in rock at these side cuts. For this work and that needed from the Deer Lodge to Fort Benton I think the amount of $70,000 should be appropriated by Congress: $20,000 to be used in the Deer Lodge section, and the remainder in the timbered belt referred to from the Bitter Root ferry to the Spokane plain.

The freshet in these mountains is a difficulty to be sternly handled, and too much care cannot be taken in selecting suitable abutment sites for bridging. The excessive amount of bridging that the Cœur d'Aléne calls for is an element of disadvantage difficult to eliminate.

Along the north fork of the Cœur d'Aléne, from Johnson's Cut-off to Long prairie, all the crossings might be avoided by making some three or four miles of excavation along the side hills. But I candidly believe the government would eventually find it to its advantage to open a line through the mountains *via* the Clark's Fork, to the Hell's Gate, and thence use my road to Fort Benton. Every advantage of climate would be then gained, and though the amount needed to open it might prove at first large, yet, looking to the fact that it could be travelled every month in the year, we have an argument so permanently in its favor that it must weigh down all other considerations, and I can only hope that the matter may yet be taken up by some person competent to handle it.

The work of covering the bridges in the valley of the St. Regis Borgia having been completed, my party moved for Fort Walla-Walla, making such repairs en route as the condition of the road called for, crossed the Spokane, and halted at Hangman's creek. This is the largest and most important stream to cross between Fort Walla-Walla and the Spokane. The freshet here, having been unusually high, had swept away the bridge erected during the last season. I determined, therefore, to choose a new site and erect a new and stronger bridge, that should defy the force of the highest freshet. Setting the men at work, we had a fine structure ready by the middle of August, when we took up our line of march for Fort Walla-Walla. By this time we were overtaken by several small parties of emigrants, who had come from St. Louis by the steamers before referred to, and were now on their way to Walla-Walla. I aided all in every way in my power, and furnished supplies to those who needed them, also leaving memorandum notes from point to point, setting forth the best camping grounds, &c.

All these emigrants were a very proper class of persons, mostly from the western States, where the civil troubles had caused a number to look towards the Pacific in quest of new homes. They had made the journey on the steamers in from thirty to forty days from St. Louis, and, purchasing their land outfit at Fort Benton at very moderate figures, were journeying safely and pleasantly towards the setting sun. The safe passage of these emigrants during this season proves the value of this line for emigrant purposes, and will yet cause it to stand in competition with other lines across the continent. From the Spokane to Walla-Walla we found the road in good condition, and it will hereafter only require those slight repairs always demanded on the best of turnpikes to keep it in excellent order.

Reaching Walla-Walla late in August, I disposed of my property at public auction, disbanded my expedition, and on the 11th of September started for Washington city, to make my report to the War Department. Thus ended my work in the field, costing seven years of close and arduous attention, exploring and opening up a road of six hundred and twenty-four miles from the Columbia to the Missouri river, at a cost of $230,000. That it will subserve the many purposes claimed for it by its friends I can only sincerely hope that time may eventually prove. With every disposition on my part, it is impossible here to give those details of construction where special difficulties arose day by day for solution, the many trying positions in which I found myself placed during so long a period, the many discomforts put up with by my men, who yet retained all their cheerfulness.

Suffice it to say, we succeeded to our own satisfaction in accomplishing the full object of our mission, and those who by their cheerful aid lent me their co-operation have here my most heartfelt thanks.

GENERAL DIVISION OF ROUTE.

Our road involved one hundred and twenty miles of difficult timber-cutting, twenty-five feet broad, and thirty measured miles of excavation, fifteen to twenty feet wide. The remainder was either through an open, timbered country, or over open, rolling prairie. From Walla-Walla eastward the country might be described in succinct terms as follows: First one hundred and eighty miles, open, level. or rolling prairie; next one hundred and twenty miles, densely timbered mountain bottoms; next two hundred and twenty-four miles, open timbered plateaus, with long stretches of prairie; and next one hundred miles, level or rolling prairie. Thus it is seen that the Rocky and Bitter Root mountains rise midway in our route, with long prairie slopes on either side; that the latter are intersected in every direction by streams flowing from both water-sheds, and rising in the heart of the mountain system; that these prairie stretches interpose but slight obstructions to the location of a road, and it is only in the more elevated central sections where our sterner engineering problems are to be met.

ITINERARY OF ROUTE.

For those who would desire to know in detail the special features of each day's march, as well as each camp ground and distance, or who might desire to retrace the steps herein described, the following itinerary is furnished, viz:

First day.—Leave Walla-Walla and move seven and a half miles, to Dry creek, and encamp at crossing; easy rolling prairie hills en route; wood, water, and grass at camp.

Second day.—Leave Dry creek and move eleven and a half miles, to Touchet bridge, and encamp; easy rolling prairie hills en route; wood, water, and grass abundant.

Third day.—From Touchet take wood in wagons for two days; move seven miles, to the springs, and encamp; grass and water here, but no wood; level prairie road en route.

Fourth day.—Leave springs and move to Snake river; distance, twenty miles; grass, water, and drift wood here; graze animals on hills on left bank; good road over rolling prairie, somewhat hilly.

Fifth day.—Cross Snake river by ferry-boat; charge for wagons, $4; men, fifty cents each; riding and pack animals, fifty cents each; swim loose stock, or, if preferred, ferry same. Move to Palouse; distance, fourteen and a half miles; water and grass; willows for fuel. It would be well to take a small quantity of drift wood along from Snake river; good road.

Sixth day.—Move to Cow creek; distance, eleven miles. Wood, water, and grass at camp; good place to rest animals for a day, if required.

Seventh day.—Move to Aspen Grove; distance, 18 miles; good road. Wood, water, and grass at camp; good place to rest animals a day, if required.

Eighth day.—Move to Lagoon camp; distance, twenty-one and a half miles; good road; wood, water, and grass at camp.

Ninth day.—Move to Rock creek; distance, twelve and a half miles; somewhat stony, but animals should be shod, in which case they will travel well; wood, water, and grass at camp.

Tenth day.—Move to Hangman's creek; distance, nineteen miles; good road; wood, water, and grass at camp.

Eleventh day.—Move to Spokane river; distance, twelve and a half miles, and cross; wood, water, and grass at camp; good place to rest animals; charge for each wagon, $4; for each man, fifty cents; swim loose stock, or ferry, if preferred. There is a ford eight miles above.

Twelfth day.—Move to camp on Spokane, at the edge of the timber; distance, sixteen miles; good road; wood, water, and grass abundant.

Thirteenth day.—Move to Wolf's Lodge prairie; distance, eighteen miles; road hilly in places, but not bad; wood, water, and grass at camp.

Fourteenth day.—Move to the Cœur d'Aléne mission; distance, seventeen miles; road hilly at one or two places, but not bad; wood, water, and grass at the mission. Good place to rest animals for a day or two, and which is by all means advisable, as you now enter the timber, where camp-grounds have to be specially selected, and the animals should be well rested. Vegetables may be had at the mission.

Fifteenth day.—Move to Mud or Ten-Mile prairie; road good; in very early spring may be wet in places; good camp for wood, grass, and water. A good camp may also be had in seven miles from the mission, in open timber; water three hundred yards to the north of road, in running creek; good place for animals.

Sixteenth day.—Move to the fifteenth bridge; good water and wood; grass is not very abundant, but there are a number of small prairies above and below this bridge where grass is found; about half a mile below the bridge, on right bank, is a fine prairie; road good; distance, sixteen miles.

Seventeenth day.—Move to Johnson's Cut-off, which is a ravine from the north. The head of this ravine and the hills around it furnish an abundance of grass. This *may be* the worst day's march, as it involves many crossings, and the road may be wet; distance, eleven miles. An endeavor should be made to camp here at the risk of getting late into camp.

Eighteenth day.—Move to Long prairie; distance, three miles; road good, unless during the freshet, when some of the crossings may be swollen. Long prairie is one mile long, one-fourth of a mile broad; grass in large portion; grass also on hills to its north, just before the descent into the prairie; a blind trail leads to it through the timber.

Nineteenth day.—Make an early start and cross summit of Bitter Root mountains; may have to double teams at second curve. Move to the Five-Mile prairie, on St. Regis Borgia river; distance, eleven and a half miles; grass sparse; wood and water abundant.

Twentieth day.—Move eleven and a half miles to Sawyer's prairie; wood, water, and grass abundant; road good.

Twenty-first day.—Move to Cantonment Jordan, five and a half miles distant; grass half a mile above camp; wood and water everywhere.

Twenty-second day.—Move to Bitter Root ferry; distance, fourteen and a quarter miles; wood, water, and grass abundant.

Twenty-third day.—Cross ferry and go to Seven-Mile prairie; charges for crossing the same as at the Spokane and Snake ferries. The stream is fordable in very low water, but I would advise all strangers to cross in the ferry-boat, as the ford is a dangerous one, except to those who know it well. Rest your animals at this point. Good camp, with wood, water, and grass.

Twenty-fourth day.—Move nine and a half miles to Brown's prairie; good road; wood, water, and grass at camp.

Twenty-fifth day.—Move fifteen and a half miles to west end of big side-cut, and camp at foot of mountain, on small creek. Wood, water, and grass abundant; may have to double teams over Brown's Cut-off divide, going either way; road good, with this exception.

Twenty-sixth day.—Move over big side-cut to a camp on Main river, one mile above the Rocky Points, where the road passes through a rocky defile; distance, seventeen miles; road fair; wood, water, and grass at camp.

Twenty-seventh day.—Move to Brown's house, twelve miles distant; road good; wood, water, and grass at camp.

Twenty-eighth day.—Move to Higgin's & Worden's store, at Hell's Gate, distance twelve and a half miles; road excellent; wood, water, and grass here; good place to rest animals for a day or two; blacksmith's shop at Van Dorn's, and supplies of all kinds can be obtained, dry goods, groceries, beef, vegetables, and fresh animals, if needed.

Twenty-ninth day.—Move to Big Blackfoot bridge, eleven miles; road good; wood, water, and grass abundant.

Thirtieth day.—Move to Campbell's camp, fifteen miles; excellent road; good wood, water, and grass abound.

Thirty-first day.—Move to Lannon's camp, nine miles; road excellent; may have to double teams at Beaver Tail butte; wood, water, and grass abundant.

Thirty-second day.—Move eleven miles to Lyon's creek, crossing en route Hell's Gate bridge; road good; wood, water, and grass at camp.

Thirty-third day.—Move to Flint creek, distance eleven miles; road somewhat hilly but still not steep; wood, water, and grass at camp.

Thirty-fourth day.—Move thirteen and one half miles to Gold creek or American Fork of Hell's Gate river; road excellent; wood, water, and grass at camp; supplies of all kinds to be had here, dry goods, groceries, fresh beef, animals, and possibly vegetables.

Thirty-fifth day.—Move to Deer Lodge river, distance sixteen miles; road hilly but not requiring double teaming; wood, water, and grass at camp; Deer Lodge would be found a good place to rest for a day or two; fresh beef to be had here from the settlers.

Thirty-sixth day.—Move to Little Blackfoot river, seventeen and a quarter miles; road generally good, hilly at one or two points, but not steep; good wood, grass, and water at camp.

Thirty-seventh day.—Move to west base of Rocky Mountains, at Mullan's Pass, thirteen and a half miles; road generally good, though sometimes wet in early spring; no ascending the north fork of Little Blackfoot; wood, water, and grass at camp.

Thirty-eighth day.—Cross summit of Rocky Mountains and go seven miles to Fir creek; road good; wood, water, and grass at camp.

Thirty-ninth day.—Move seventeen miles to Little Prickly Pear creek; road hilly in places but not bad; camps at shorter distances can be made, as several creeks are passed en route; Soft Bed creek midway offers a good camp; this would be a good place to rest animals.

Fortieth day.—Start early and go over Medicine Rock mountain fifteen and a half miles; this is the worst day's march; road rocky in places, but, with care, easily made; wood, water, and grass at camp on Oversight creek.

Forty-first day.—Move twenty miles to the Dearborn river; wood, water, and grass at camp.

Forty-second day.—Move to Bird Tail Rock, fifteen miles; road excellent; water and grass at camp; willows for fuel but scant; it would be well to pack wood from the Dearborn or Sun rivers, according to which way you are travelling.

Forty-third day.—Move to Blackfoot agency, on Sun river, eighteen and a half miles; excellent road; wood, water, and grass at camp; good place to rest animals for a day or two; in high water there is a ferry-boat for crossing.

Forty-fourth day.—Move eight miles to the point where you leave Sun river; road excellent; wood, water, and grass at camp.

Forty-fifth day.—Move sixteen miles to the lake; road excellent; water and grass; take wood from camp.

Forty-sixth day.—Move to the springs, seven miles; water and grass, but no wood; or you can go to the Big coulée, sixteen miles further, and encamp on the Missouri river; road good.

Forty-seventh day.—Move to Fort Benton, twenty-seven miles, if you encamp at the springs, or eleven miles if you encamp at the Big coulée. The latter never was a portion of my road, but was worked by Major Delancy Floy Jones, and I am not responsible either for its location or the character of the work performed.

If you are going from Fort Benton, it would be preferable to camp at the spring. This can be accomplished by starting early; and I should advise all parties travelling with wagons to avoid the Big coulée. If water be not sufficiently abundant at the springs, then encamp at the lake. It may be found best to start at dawn and make the lake. The road is excellent.

The total distance herein given is six hundred and twenty-four miles, made in forty-seven days travelling; or, allowing eighteen days for delays, contingencies, and recruiting animals, in fifty-five days, with loaded wagons; or in thirty-five days if you are travelling with pack animals.

RECOMMENDATIONS FOR TRAVELLERS.

For persons who desire to leave St. Louis in the spring on steamer for Fort Benton, where the passage is from $40 to $100, and freight from 5 cents to 10 cents per pound, and who desire to make the land transit by wagon, I would advise that they provide themselves with a light spring covered wagon in St. Louis, also two or four sets of strong harness, and transport them to Fort Benton, where they can procure their animals, mules or horses. The former can be had from $100 to $150, the latter from $50 to $75; oxen, from $100 to $125 per yoke. Let them provide themselves with a small kit of good strong tin or plated iron mess furniture; kettles to fit one in the other, tin plates and cups, and strong knives and forks; purchase their own supplies in St. Louis; brown sugar, coffee, or tea, bacon, flour, salt, beans, sardines, and a few jars of pickles and preserved fruits will constitute a perfect outfit in this department. I have found that for ten men for fifty days, the following is none too much on a trip of this kind: 625 pounds of flour, 50 pounds of coffee, 75 pounds of sugar, 2 bushels of beans, 1 bushel of salt, 625 pounds of bacon side, 2 gallons of vinegar, 20 pounds of dried apples, 3 dozen of yeast powders, and by all means take two strong covered ovens, (Dutch ovens.) These amounts can be increased or diminished in proportion to the number of men and number of days. If your wagon tires become loose on the road, caulk them with old gunny sacks, or in lieu thereof, with any other sacking; also, soak the wheels well in water whenever an opportunity occurs. In loading the wagons, an allowance of four hundred pounds to the animal will be found sufficient for a long journey. For riding saddles, select a California or Mexican tree with machiers and taphederos, hair girth, double grey saddle blanket, and strong snaffle bit.

If the intention is to travel with a pack train, take the cross-tree packsaddle, with crupper and breeching, and broad thick pads. Use lash-rope, with canvas or leather belly bands. Have a double blanket under each saddle. Balance the load equally on the two sides of the animal—the whole not to exceed two hundred pounds. Have a canvas cover for each pack. A mule-blind may be found useful in packing. Each pack animal should have a hackamo, and every animal (packing and riding) a picket-rope, from thirty-five to forty feet long and one inch in diameter. For my own purposes, I have always preferred the apperajo for packing, and have always preferred mules to horses. Packages of any shape can be loaded upon the apperajo more conveniently than upon the packsaddle. A bell animal should be always kept with a pack train, and a grey mare is generally preferred. Every article to be used in crossing the plains should be of the best manufacture and strongest material. This will, in the end, prove true economy. Animals should be shod on the fore feet, at least. Starting at dawn and camping not later than 2 p. m., I have always found the best plan in marching. Animals should not go out of a walk or a slow trot, and after being unloaded in camp they should always be allowed to stand with their saddles on and girths loose, for at least fifteen minutes, as the sudden exposure of their warm backs to the air tends to scald them. They should be regularly watered, morning, noon, and night. Never maltreat them, but govern them as you would a woman, with kindness, affection, and caresses, and you will be repaid by their docility and easy management. If you travel with a wagon, provide yourself with a jackscrew, extra tongue, and coupling pole; also, axle grease, a hatchet and nails, auger, rope, twine, and one or two chains for wheel locking, and one or two extra whippletrees, as well as such other articles as in your own judgment may be deemed necessary. A light canvas tent, with poles that fold in the middle by a hinge, I have always found most convenient. Tables and chairs can be dispensed with, but if deemed absolutely necessary, the old army camp stool, and a table with lid that removes and legs that fold under, I have found to best subserve all camp requisites. Never take anything not absolutely necessary. This is a rule of all experienced voyageurs.

ADVICE TO EMIGRANTS BY THIS ROUTE.

Those who start from the upper Mississippi frontier can replenish their original supplies at Fort Union, at the mouth of the Yellowstone, at Fort Benton, and, in addition, at the other points hitherto alluded to.

Those who travel by the central or Platte route, and desire to take the western section of our road to Walla-Walla, can deflect either at Fort Laramie, the Red Buttes, or Fort Hall, and connect with it at the Deer Lodge valley.

The road from Fort Laramie to the Deer Lodge valley has never been worked, but was passed over with wagons by Captain Raynolds, of the army, in 1859 and 1860, on a tour of exploration, and reported upon by him as practicable. It passes through a beautiful, easy, and interesting region.

The road from Fort Hall to Deer Lodge has been used by wagons for many years, and though not worked is quite practicable.

AGRICULTURAL LANDS.

The amount of agricultural land along the general line of the road may be safely estimated at one thousand square miles, or six hundred and forty thousand acres.

The largest single body is found in the Walla-Walla valley, where its rich soil, freedom from early frosts, and with the mild climate there found, constitutes it a great agricultural centre. Corn, oats, barley, spring and autumn wheat, tobacco, and every variety of vegetable, are here grown in great abundance; wheat, thirty bushels to the acre; barley and oats, forty bushels, and corn from sixty to eighty bushels, and potatoes from three hundred to six hundred bushels to the acre. The grape and peach will be found to grow well here, and when the country is settled the oak will take its place among the chief forest growth.

The mines furnish a ready market for all that is raised, cash payments for which are made in gold.

Fruit-growing is attracting attention and thus far promises well. Erection of grist-mills keep pace with the growing demands of the country. Another favorite agricultural tract is the Dry creek; its valley is already studded with beautiful farms; so also the Touchet, where there is still room for the industrious emigrant.

At the mouth of the Palouse is a small tract of good land, enough for one small farm, and which, as trade and travel increase, must become an important point.

Several tracts of good soil are found along the Palouse, but the absence of timber is an impediment not easily supplied.

Small tracts are found along the Cow creek and along the road to Aspen Grove, and many in the direction of the long line of lagoons found along the road.

An excellent body of good land is found along Lake Williamson, and along several of the smaller lakes and creeks to its mouth.

Several small bodies are found along both banks of the Spokane; near the Foot Hill several farms are already under culture. Along the upper Spokane are also small bodies. At the Cœur d'Aléne mission is a body of five or six square miles of most beautiful soil; several hundred acres are here under cultivation by the mission and the Indians. Oats, barley, wheat, peas, and potatoes, are raised in rich abundance.

One of the largest bodies of good land is in the valleys of the St. Joseph's and Cœur d'Aléne, and if these valleys are once drained, a body of forty thousand acres of the finest soil in the world will be reclaimed—soil six and eight feet deep and as black as a coal. This overflow can be prevented by widening the natural outlet, and making an artificial one along side of it; an appropriation of five thousand dollars will meet this difficulty, and the ends to which it looks are well worthy the experiment. Rock blasting is the only method of accomplishing it, and should be done during a low stage of water. The overflow is alone occasioned in the highest stages of water, when the mouth of the outlet of the lake is not capacious enough to discharge the volume of water sent into it by its feeders.

On the right bank of the Cœur d'Aléne, opposite the mission, is a mile square of beautiful soil. Four-Mile prairie has a good body of land, also Ten-Mile prairie.

From this point to the Bitter Root ferry, I fear the frosts and other mountain characteristics will preclude any farms from being opened.

At the mouth of the St. Regis Borgia, however, several tracts of land are found, and which, if cultivated, will come into requisition for mail stations, and supplying travellers and emigrants. Seven-Mile prairie along the Bitter Root river offers a good site for small farms; also Brown's prairie, Nemoté prairie, Skiotay creek, where the wild timothy abundantly grows, and many large and beautiful tracts along the right bank of the main Bitter Root. Frenchtown, in Hell's Gate ronde, already contains from ten to fifteen small farms, and there is room for many more. The small creeks in Hell's Gate ronde offer many choice sites for farms; a dozen at least are here now under cultivation. Wheat, potatoes, oats, and barley, and all vegetables are raised. Corn is not matured, but is raised for roasting ears. The St. Mary's valley to the south, and the Jocko and Flathead valleys to its north, are large and favorite farming sections.

Among the small creeks tributaries to the Hell's Gate, four and five miles from Big Blackfoot, at Clark's camp, at Beaver Dam butte, and along some of the smaller water-runs good soil is found. The upper portion of the valley of Flint creek may be found suited to agriculture.

From Flint creek to the American fork are many beautiful localities where farms may be opened. A large and beautiful one is already opened by a Mr. Dempsey, where he grows oats and wheat luxuriantly. The American Fork has some beautiful bodies of land along it. The Deer Lodge is a large and well located valley and contains from fifty to one hundred and fifty square miles, where crops have already been grown. Along the Little Blackfoot and its smaller tributaries are found patches of good soil. From this point to the Big Prickly Pear creek the altitude and wet condition of the soil may prove impediments to successful or economical culture.

Crossing the divide we get into a new climate and change of soil; along the Big Prickly Pear will be found several small and choice localities for farms, and if the mines on the eastern slope prove successful, I look forward with much hope to see all these creeks settled and fine farms developed under the hand of the Rocky Mountain farmer. All the small creeks from the Big Prickly Pear to the Bird Tail Rock have smaller bodies of good soil, and if the mines prove a reality a market will be at hand for all they can raise.

To the south of the Bird Tail Rock, about three to five miles in a wild broken region, through which a wagon road can be laid to shorten our line from Sun river to the Dearborn, is one of the largest and richest bodies of land that I have seen east of the mountains, and where timber from the mountains and rock at hand will supply all the requisites of the first settlers. Situated, as it is, midway between Fort Benton and the Prickly Pear gold mines, it is worthy an examination on the part of those who propose to settle in the country. I examined it on my return from Fort Benton, June, 1862, to see if we could not shorten our line by going south of the Bird Tail Rock. With moderate work I found this feasible, and saving from eight to ten miles in distance; and it was on this trip that I was struck with the richness of the soil and the extent of agricultural land here found. It is a favorite resort for game, and sheltered, as it is, by high rock walls from the cold bleak winds which sweep across the plains, forms a choice site for farms.

The next good track is along the Sun river, where a stiff clay soil is already cultivated to advantage. The Blackfoot agency has a farm of from thirty to forty acres under cultivation, and raises wheat and vegetables. Its valley is from fifty to one hundred and fifty feet below the general level of the Missouri plains, and is thus sheltered from the colder winds that sweep across them at spring seasons. Some patches of good soil are found along the Missouri above Fort Benton, but their culture has never been tested. There are enough statistics of growth from actual cultivation along the line to show that the many areas herein referred to will grow abundant crops, and all of which will come under tillage as soon as a market presents itself. At all the points referred to abundant building material and water are at hand, and mill sites can be had on nearly every water-course. There are already three grist and two saw mills in the Walla-Walla valley, one grist-mill at the Cœur d'Aléne mission, one saw and one grist mill at Frenchtown, one saw and one grist mill at the Pend d'Oreille mission, one saw-mill at the Jocko river, and one saw and one grist mill at Fort Owen; one steam saw and one grist mill owned by La Barge & Co., which they propose to erect near the Deer Lodge gold mines. The Blackfoot agency use a small hand-mill for grinding their wheat.

As an experiment, the value of which another season will develop, I had shipped from St. Louis to Fort Benton, and thence packed over into the Bitter Root mountains, twenty-four bushels of blue grass seed and twelve bushels of clover seed, and sowed them at the crossing of the Bitter Root, along the valley of the St. Regis Borgia and the Cœur d'Aléne to the mission, wherever the grass was sparse. The seed was thrown broadcast over the ground and through the woods, and over the prairie, at such points as are likely to be selected as camping-grounds. This wooded section of one hundred miles is the only point where grass is at all scarce, and this experiment was made by myself to meet fully all the wants of a future and large emigration over the road.

GRAZING CAPABILITIES.

The experience of all persons travelling through this region has been that, from the Columbia to the Missouri rivers, finer grasses have never anywhere been seen; the number and condition of the stock that feed upon the wild grass alone shows both their abundance and nutrition. Wild hay can be, and is, cut from thousands of acres. The grass is mostly a wild bunch grass, growing from twelve to eighteen inches high, and covering the entire country. Horses and horned-stock by thousands, and sheep by hundreds, all bespeak the wealth that is wrapped up in the native grasses of the north Pacific region, and I confidently look forward to seeing the wealth of these beautiful mountain valleys yet consist in the thousands of fleecy flocks to be here sheared; and if the streams of the Rocky Mountains are themselves caught and harnessed to the spindles and looms of wool manufactories to be there erected, that the annual shipments of wool to a St. Louis market will constitute a trade replete with wealth and magnitude. I believe it to be an ordination of Providence that as the buffalo that now blacken the western plains by their millions of shaggy coats disappear with the red man, whose sustenance they now are, their place will be supplied by the silvery fleeces of millions of sheep tended by white men, which this region is capable of sustaining. The wolves now exist in places as an impediment to much attention being given the subject, but travel and settlement soon destroy them. The premiums on cotton which is soon to be transferred to wool render this question one of great magnitude for this region, and I yet hope to see the genial valleys of the Rocky Mountains send to a St. Louis market, *via* the upper Missouri river, its cargoes of wool and its shipments of gold, as its natural tribute to our national wealth.

MINERAL WEALTH.

It has been only during the last three years that sanguine expectations have existed of mineral wealth to any great extent being found east of the Cascade mountains or even in the northern portion of the Rocky Mountains proper. As soon as the Frazier river mines in British Columbia were discovered and the question of route by which to reach them in the shortest time and cheapest means was discussed, we found the eastern portion of Washington Territory ramified by hundreds of gold seekers in quest of this new Eldorado. This was in 1858. Gold was soon after discovered in the Wenatchee, Nachees, Okinagen, Simalkameen, and Clark's Fork, and worked till the Indians drove the miners from the country. In the succeeding year Captain Pierce, with a boldness and a judgment worthy every commendation, explored the Bitter Root mountains, and the discovery of the Nez Percés gold mines was the result. The wanderings of the miners in this region southward led to the Salmon river discoveries. But the gold miner, who is the most restless of mortals, did not rest content until he had crossed Snake river and discovered the Powder river mines; and not even then content, he opened up the Grand Ronde, Boisé, and Burnt river mines, in East Oregon, and elated at his success returns to his friends in West Oregon, taking the head of John Day's river in his route only to discover the richest quartz leads to be found outside of California.

His companions on Frazier's river heard of this new gold field and they too must visit it, taking on their route the mouth of Clark's Fork and Spokane river, only there to discover gold which has since been taken out by the pound. This news spreads and the Powder river miner tracks it to the latter point, and thence to the Kootenay, where he is amply repaid for his toil and travel. While this is being done the Salmon river miner is not content with making twenty dollars per day, but he too must follow the Salmon river till it becomes a silvery thread in the mountains and crosses the range to discover the wealth of the Deer Lodge mines. As the weary emigrant crossing the plains hears of this Eldorado so near himself, he too must journey thither only to discover the rich gold mines in Big Hole and Beaver Head valleys. Nor does it stop here, but the restless adventurer in St. Louis contracts the gold fever and threads the Missouri to Fort Benton in quest of the Deer Lodge mines, and while en route discovers the Prickly Pear gold mines. Thus, working like beavers, have the miners and emigrants crossed and recrossed the mountains during the last three years, ramifying in every direction until they have opened a gold region which, to-day, is sending to our mints a wealth equal to that of all California in her palmiest days.

Nor are these discoveries limited to the investigations of the miner or alone confined to the limits of our own territory, but the Catholic fathers in British Columbia have made equally rich discoveries at the headwaters of the Saskatchewan river and at Chief Mountain lake, so that now gold is being profitably taken out at the following points: at John Day's, Grand Ronde, Powder river, Burnt, and Boisé, and Owyhee rivers, in East Oregon; in the Nez Percés mines, Salmon river, Spokane, Clark's Fork, Simalkameen, and Deer Lodge, in East Washington Territory; and at Big Hole, Beaver Head, and Prickly Pear, in West Dacotah.

The result of Captain Raynolds's explorations would show that traces of gold were found by his party in all the tributaries to the upper Yellowstone from the south. Enough discoveries have been made to warrant us in thinking that the entire mountain system will be found to be gold bearing.

Gold has also been discovered in the Big Blackfoot, Flathead, Kootenay, and Bitter Root rivers, and slight traces in the Cœur d'Aléne and St. Regis Borgia.

I do not hesitate to say, upon the best of guidance, that the lower Clark's Fork will yet prove a rich gold region. The richest quartz leads yet found are in the John Day's. The other diggings are mostly surface or placer.

Wonderful have been the effects of this great alchemist in that quarter. It has transmuted sluggishness into activity, has brightened the dullest vision, elevated the industrious and frugal laborer, silenced the sceptic and caviller, and struck a new blow in behalf of a northern Pacific railroad route. The trade and travel along the upper Columbia, where several steamers now ply between busy marts, of themselves attest what magical effects three years have wrought. Besides gold, lead for miles is found along the Kootenay. Red hematite iron ore, traces of copper and plumbago are found along the main Bitter Root. Cinnabar is said to exist along the Hell's Gate and at a point along the upper Missouri. Coal is found along the upper Missouri, and a deposit of cannel coal near the Three Buttes, northwest of Fort Benton, is said to exist. Near the headwaters of the Kootenay coal is also said to exist. Coal may yet be looked for east of the Cascades. Iron ore has been found near Thompson's prairie on the Clark's Fork. Sulphur is found on the Lo-Lo Fork and on the tributaries to the Yellowstone; and a coal-oil spring is said to exist on the Big Horn river, a tributary to the Yellowstone.

It would be natural to suppose that the Rocky Mountain system, which, beginning far down in Mexico, there develops its wealth in gold and silver, and continuing northward to Pike's Peak would still retain its same geological characteristics as we trace them northward; and this we find to be the case, and on both slopes *at about the same altitude above the sea do we find these rich deposits.* What is true here is also true of the coast range, so that the Sierra Nevadas of California do not lose any of these characteristics when they become the Cascades of Oregon. We find that though for many years the gold region was limited to the western slopes and spurs of the Sierra Nevada, yet mineralogy pointed out that a Washoe *must* exist, and hence developments of fabulous wealth were made on the east slopes of the Sierra Nevada, only to be followed by equally rich deposits now being worked on the eastern slopes of the Cascades, in Oregon.

These great mineral deposits must have an ultimate bearing upon the location of the Pacific railroad, adding, as they will, trade, travel, and wealth to its every mile when built.

BUILDING MATERIAL.

The great depots for building material, stone, timber, and limestone, exist principally in the mountain sections, but the plains on either side are not destitute in this particular; white and red fir, and white and yellow pine are found at Walla-Walla, in the Blue mountains, on the Clearwater where cedar is added, and all through the Bitter Root and Rocky Mountains the finest white and red cedar, white pine and red fir, that I have ever seen are found.

Between the Cœur d'Aléne mission and Hell's Gate spruce, hemlock and birch are also found. The elevation at the Dalles and the line of longitude passing through it is the eastern limit of oak, which is traced from the coast eastward. We have no hard woods in this region, and, indeed, nearly all the hard woods used in California and Oregon are shipped around Cape Horn. Even the oak found in the Pacific is of an inferior growth, generally wind shaken and but little used in the mechanical arts. Timber is found until within 120 miles of Fort Benton; it grows also along the upper Missouri and all its tributaries where it can be rafted down. All the rivers here lend themselves admirably to rafting purposes.

Limestone is found on the Clearwater, near the Cœur d'Aléne lake, in the Cœur d'Aléne mountains, in Hell's Gate, in the Bitter Root valley, and head of the north fork of the little Blackfoot river. Beautiful red sandstone is found along the Bitter Root river. Slates are found along the Cœur d'Aléne, St. Regis Borgia and Bitter Root. Excellent gray sandstone is found in the Bitter Root mountains, from which grindstones and scythe-stones have been made, and good burr-stones for mills have been got out of the mountains and used by the Jesuit fathers. Good sand is found along the Columbia, along the Spokane and Cœur d'Aléne and along the Hell's Gate rivers.

RIVERS AND WATER-COURSES.

The entire length of road from the Columbia to the Missouri may be said to follow one continuous line of water-courses, one of the chief recommendations of which is that not one is alkaline; but the water is of a delicious purity.

This fact on a long line of march with much stock is an advantage that all who have crossed the plains will not fail to appreciate. In the first stretch of fifty miles we cross the Walla-Walla, Mill creek, Dry creek, and Touchet river. They all rise in the Blue mountains, the last three flowing into the Walla-Walla river, and the last into the Columbia, at the town of Wallula.

The Snake river, or the south fork of the Columbia, is the most considerable stream crossed; it rises in the Wind River mountains, and is about one thousand miles long. It is navigated by steamers of heavy draught as far as Lewiston till the 1st of August, and light draught steamers have run as late as the 29th of September; and, during the coming year, it is proposed to run steamers as far as Fort Boisé, to supply the mines on either side at this point. Steamers have run up the Clearwater above the Lapway, but only during the highest stage of water.

There is no timber along this portion of the Snake river, and steamers have to depend on drift wood, of which there has always been ample up to date. But fuel can be rafted down from the Clearwater.

The importance of the Snake river for purposes of steam navigation begins now to be thoroughly appreciated. The cost of transportation is a large item, but as long as the mines continue to pay as well as they now do, so long will it pay to run steamers on this river. The scale upon which nature has worked in this region is wonderful. Though she has interposed great physical obstacles, both in rivers and on land, to the opening of the country and speedy travel, she has, nevertheless, at the same time placed in the same region great areas of gold fields, the wealth from which is destined to so meet these obstacles that it is only a question of time when this region will boast of as rapid and as cheap travel as regions where the physical difficulties have been fewer, but the ends sought not so stimulating as the search and mining for gold has proved to be.

The next stream of note is the Palouse, which, rising in the Bitter Root mountains, has a length of ninety miles, unsuited to either navigation or rafting purposes. Its banks are not timbered for a stretch of forty miles from its mouth. Its minor tributaries, north and eastward, only enter as elements of advantage for camping purposes. The great number of lakes found on the plains of the Columbia enter as marked features in this immense area.

Hangman's creek rises in the Bitter Root mountains, has a length of fifty miles, and empties into the Spokane; has no special value outside of affording camping facilities. The Spokane is the outlet of the Cœur d'Aléne lake, is one hundred miles long, and drains throughout a timbered region, and enjoys special advantages for rafting purposes. Its mouth is the southern limit for timber along the main Columbia.

Gold mines exist at and above its mouth. A project has been conceived to open a canal from the Clark's Fork at the Pend d'Oreille lake to the Spokane, the elevation being suited for this purpose, and the Clark's Fork, with the Pend d'Oreille lake, offers marked advantages for steam navigation for at least eighty miles. My idea has always been that steam on the Clark's Fork, at Park's crossing, running thirty miles to the lake, and thirty miles across the lake, and twenty miles up the Clark's Fork, would reach a point where a cheap wagon road could be opened to the Hell's Gate, and that for all purposes of travel, carrying mails, and emigrant purposes, that in time this would be done.

I do not know what special advantages are expected to be derived from the canal referred to, nor do I think it will be undertaken unless this region should prove a very rich and extensive gold field. The Cœur d'Aléne lake and its two arms can be navigated by steam, and enjoy special advantages for rafting purposes.

The Clark's Fork, which is the middle fork of the Columbia, is a most important stream, and enjoys pre-eminent advantages for rafting purposes. It is fed by two large forks, the Flathead river from the north, and Bitter Root from the south.

The St. Regis Borgia enjoys no special advantages outside of defining a valley, and being useful for camping purposes. Its frequent crossings have rendered it rather an element of disadvantage.

The Bitter Root river, with its three large tributaries, Big Blackfoot, Hell's Gate, and St. Mary's rivers, enjoy special advantages for rafting purposes, and though here and there are stretches suited to steam navigation, yet, broken as it is in its length by falls and rapids, precludes the possibility of its ever being used for such purposes.

Crossing the Rocky Mountains we find none of the tributaries of the upper Missouri along our immediate line enjoying any special advantage, except the Dearborn and Sun rivers, both of which might be used for rafting timber and stone from their headwaters; the Sun river more so than the Dearborn. The upper Missouri, with its three forks, enjoys special advantages both for navigation and rafting purposes. The distance from the falls of the Missouri to the Three Forks is about one hundred and seventy-five miles, and though the water is rapid at a few points, yet in the lowest stage of water steamers can run; and here is a field for enterprise and bold experiments never as yet tested, and which cannot long lie dormant if the Prickly Pear, Deer Lodge, and Beaver Head mines prove a growing reality.

At present steamers from St. Louis land at Fort Benton, but they can run forty miles further to the foot of the falls. If steamers are put on above the falls a portage of fifteen miles becomes necessary.

The mouth of a small creek from the south, called Portage creek, affords a good landing site. The river from this point to Fort Benton is broad and bold, with plenty of cottonwood fuel on the small creeks and on the main river.

The portage will have to be made on the south bank, as the great number of coulées and broken country on the north bank will render a road expensive, if not impracticable. On the south bank, by keeping back, say two or three miles from the river, we head all the coulées, and have a level and beautiful plain till reaching the head of the falls, when you descend to the river bank by a gradual slope at the White Bear islands, just below the mouth of Sun river, where the Missouri is again a clear, bold, and placid stream.

The great falls of the Missouri form the only feature of great beauty in this region, and are well worthy a visit. The falls begin nine miles below the mouth of Sun river, and continue in a stretch of thirteen miles with rapids, falls, and cascades, gaining in this distance a total fall of 380 feet.

The lower falls are the largest, being 84 feet, where the stream is 480 yards wide, the southern half of which, in a single sheet, leaps over a ledge of sandstone rocks, while the northern half, in a series of falls, cascades, and chutes, makes a broken descent into the basin lying at its foot. The whole rock formation here is a yellow sandstone, and the character given to the falls has depended upon the ease or difficulty with which the water has either washed the rock away to a sharp face, as in the southern half, or worn it away into plateaus and benches, as in the northern half. A high, prominent point projects into the river at the foot of the falls from the northern bank, from which you enjoy a beautiful view.

The water, the rock thinly veiled in foam, the high, bold banks, the wildness of the scene, so far from civilization, the thundering noise of the fall of the cataract, the rising of the mist, the *tout ensemble*, constituted a picture worthy the pencil of the artist and the toil of the tourist. The upper, but smaller, falls are 40 feet high, but very beautiful. Between the upper and lower are the Horse Shoe and other falls, from three to fifteen feet.

The banks on either side continue to retain throughout this entire length their wild, rocky, rugged character, so that the Missouri itself ploughs in a deep, narrow gorge one thousand feet below the general line of the plains that bound it on either side.

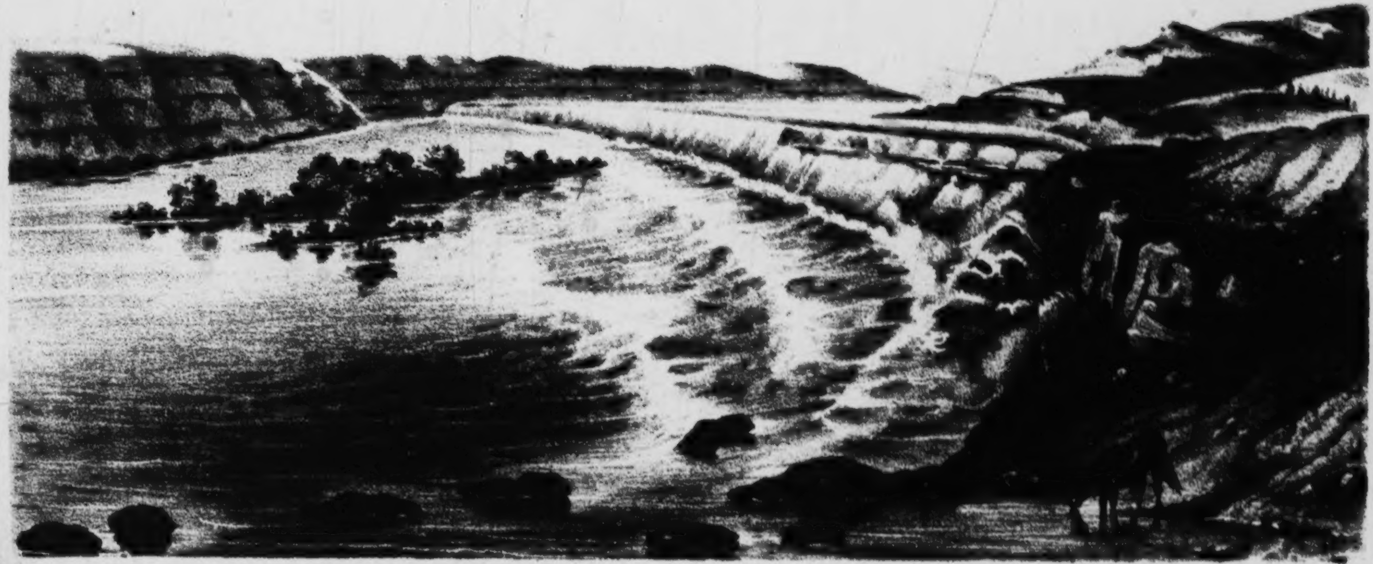
The special advantages enjoyed by the Columbia and Missouri rivers, rising, as they do, in the same sources in the Rocky Mountains, and flowing thousands of miles into two oceans, must ever enter as essential and economical elements into trade, travel, and railroad construction across the continent.

The Columbia is the only stream that rises in the main chain of the Rocky Mountains, breaking through the coast range and emptying into the Pacific. The large water-courses, with their great net-work of tributaries, lying between the 44th and 49th degrees of north latitude, must ever cause this region to enjoy facilities given by nature to no other west of the Mississippi. These large bodies of water tend to modify the climate, supply mill sites, water farms, and grazing fields; enable the miner to work miles of sluice-boxes, the merchant to float, by steam, his wares to the very heart of the Rocky range, and stand ever ready and panting to be converted into steam for the iron horse that must soon invade their dominions.

MOUNTAIN SYSTEM.

The early geographers who attempted the mapping of the country west of the Mississippi left us a very vague and erroneous outline of the Rocky Mountain formation, or the direction of the vast system of spurs that go to form them. The dividing ridge of the Rocky range was nearly always represented as a right line trending from northwest to southeast from our northern boundary to New Mexico. This right line has, however, disappeared from our maps, as explorations have brought in from year to year the results of their researches.

The greatest deviation from a right line that occurs in close proximity to our road exists from the head of Deer Lodge valley to the Wind river chain, where the mountains enclose in a large re-entering angle the Big Hole valley. I look



Drawn by C. Sohon

UPPER FALLS OF THE MISSOURI RIVER.

Bowen & Co. lith. Philada.

forward to seeing this section become a great centre both for mining and agricultural developments. Our barometer detects this fact, that all the waters of the Clark's fork, with the Bitter Root, Hell's Gate, St. Mary's, and Big Blackfoot, flow in a basin elevated above the waters of the plains of the Columbia by seven hundred feet, and above the plains of the Missouri by five hundred feet.

The waters of the south fork of the Columbia, rising as far south as the 40th parallel of latitude, all flow northward; so, also, the Missouri and the Yellowstone, showing that they rise in higher mountains, and necessarily the points to which they flow must be lower, and hence, as you go northward within certain limits, the country must be lower, and the mountain passes have a less altitude above the sea level. Our barometer confirms this theory, and hence, from the 42d to the 48th parallel, you will find the lowest passes in the Rocky range.

The mountain formation, with their great system of spurs, can only be likened to the coral formation, as difficult to delineate on the maps, and following a rule as difficult to describe.

INDIANS ALONG THE ROAD.

The Indians met with along the line are the Palouse, Spokane, Cœur d'Aléne, Flatheads, Pend d'Oreilles, a few Snakes and Bannocks, the Blackfeet, and the mountain Nez Percés.

The Walla-Wallas and the Cayuse have all been removed to the agency on the Umatilla.

The Palouse number about two hundred, reside on the banks of the Snake and Palouse rivers, and live solely by fishing. I do not know that they cultivate the soil. The absence of any great amount of farming land in their country has always possibly prevented them from attempting it.

They have no treaty arrangements with the government, and I think they could be assigned to the Nez Percés reservation with advantage to the government and security to themselves. They are miserable creatures; have neither houses nor lodges, but live under wicker shelters. They own very few horses. The Spokanes number about five hundred; live by fishing and cultivating small patches of land. They reside, at times, on the Spokane, at times on the Spokane plains, have lodges and houses, and are superior to the Palouse. They have no treaty with the government, and they might, with the Colville Indians, be located near the military post of Fort Colville. They are friendly when it is to their interest.

The Cœur d'Alénes number about three hundred, live at the mission, and along the Cœur d'Aléne and St. Joseph's rivers. They own houses, cattle, and canoes, and with the Spokanes and Nez Percés often cross the mountains in quest of buffalo. They live by hunting, fishing, and cultivating the soil. They have no treaty with the government, and I think they should be moved to the Flathead reservation; they live partly in log-houses, mostly in skin lodges.

The Flatheads number about four hundred, and live by hunting and cultivating the soil. They are the best Indians in the mountains. They have treaty arrangements with the government, but have never gone upon their reservation on the Jocko river; no steps have ever been taken to remove them thence, and they still reside in St. Mary's valley, which, by the terms of the treaty, was guaranteed to them. They think the government has not kept its faith in not confirming this valley to them. Under judicious management they and the Pend d'Oreilles might be made to go upon a joint reservation, contemplated in a treaty made with them by Governor Stevens. They own great numbers of horses and cattle, and cultivate the soil more than any Indians except the Pend d'Oreilles. They are friendly, and under their chiefs, Victor, Ambrose, and Moïse, will always remain so unless some great injustice is done them. They and the Pend d'Oreilles go annually to the buffalo hunt on the plains of the Missouri. They live partly in houses, mostly in skin lodges.

The Pend d'Oreilles reside principally at the Pend d'Oreille mission, live by hunting, fishing, and cultivating the soil; as a tribe they are friendly, though there are some bad fellows among them. They number about five hundred souls, and have treaty arrangements with the government, though they have never moved on to their reservation.

The mountain Nez Percés number from one to two hundred, live and hunt with the Flatheads, and are an annoyance both to them and the whites. They should be either incorporated with the Flatheads or made to live with their tribe. They are generally disaffected, and cause much trouble and disturbance in the country.

With the Flatheads are found a few Indians of the Iroquois, Shawnee, and Snakes, and one or two New Mexican Indians. They all find a friendly and welcome home with the Flatheads, into which tribe they have married.

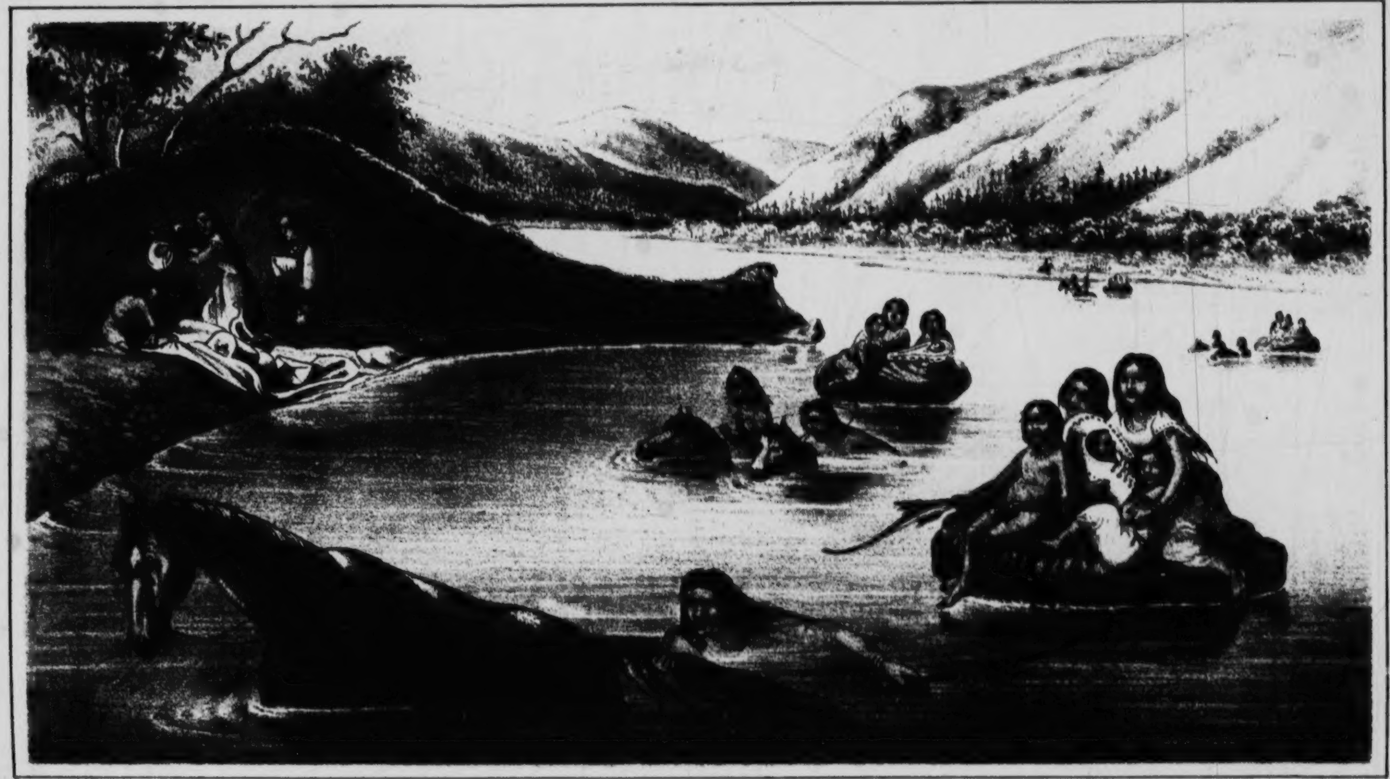
Occasionally a few Snakes and Bannocks come to the Deer Lodge valley. They live generally in the Beaver Head and on the Salmon river. I do not know their number or condition. I only know they are adept horse thieves, have no treaty arrangements with the government, and need to be looked after both for the security of the frontier settlements and their own good.

I especially invite the attention of the Indian department to the necessity of having some arrangements with the Snakes, Bannocks, and Spokanes, and point the Beaver Head out as a suitable point for collecting them on a general reservation, where a large military post should be established to keep them in order.

The Blackfeet number from eight to ten thousand souls, and live exclusively by hunting the buffalo. They live partly in our territory, to the north of Fort Benton, and partly in British territory. They have treaty arrangements with the government, and, in the absence of military force to control them, keep their faith as well as could be expected from wild savages. They are rich in horses and wives, for they are perfect Mormons in polygamy—all the other tribes practice monogamy. They are great horse thieves, though I never suffered from this propensity, to which they are greatly addicted. As a people, these Indians have as high a regard for the rights of *meum and tuum* as their superiors, the whites; and if their true condition was known at the Indian bureau, I am sanguine an improvement for the better would take place. With the present system at the bureau, however, I can only expect to see experiments and changes made until the Indian has disappeared.

The present superintendent of Indian affairs in Washington Territory, Mr. C. E. Hale, has instituted a project that I have long indorsed, and the only one likely to save any portion of the Indian tribes. This is to take the children and educate them under a proper system; for it is as difficult to mould the ideas and acts of an Indian, after he has passed the age of twenty-one, as it is those of his white neighbor; and it is only by taking the children, and rescuing them from sloth, ignorance, and savage propensities, that any decided improvement can be attained.

For myself I should like to see the supervision of the Indians transferred to the War Department, so that the hand that rewards should be the one to punish when needed, and thus produce a more uniform and harmonious management, giving greater security against outbreak, and a more economical administration of the finances of the government. If this cannot be done, of which I despair, since it aims a blow at executive patronage, then I should by all means advocate that the Superintendent of Indian Affairs be allowed to appoint his own agents. This is as natural as it is just; the agents should be directly responsible to the superintendent whom the government has charged with their general supervision, and this supervision cannot be properly maintained when the agents



Drawn by C. Sohon.

MODE OF CROSSING RIVERS BY THE FLATHEAD AND OTHER INDIANS.

Bowen & Co lth Philada

receive their authority from another and different source, and are thus inclined to slight, if not ignore, his authority.

The sphere of duties of the superintendents should never be so great as to prevent them from visiting every agency once a year; in Oregon and Washington this is impracticable; and I would, therefore, recommend the establishment of a Rocky Mountain superintendency, with its headquarters in the Deer Lodge valley, and to include the Blackfeet, Crows, Snakes, Bannocks, Flatheads, Pend d'Oreilles, and Kootenays, and that the supplies for this superintendency be taken from St. Louis, by steamer, to Fort Benton. Four agents and a sub-agent would be required: an agent for the Blackfeet, one for the Crows, one for the Snakes and Bannocks, one for the Flatheads and Pend d'Oreilles, and a sub-agent for the Kootenays. This matter is well worthy the attention of the Indian department, and to it I invite their attention, on the score of economy, efficiency, and security for the future.

POPULATION.

The white population, made up of Americans, French, and others, on and tributary to the road, may be estimated at ten thousand; found mostly at Walla-Walla and Lewiston, Deer Lodge, Hell's Gate, Beaver Head, Big Hole, Bitter Root, and Prickly Pear. They are engaged in farming, mining, transporting, merchandising, and the mechanic arts. As the mines develop, this population will be largely added to annually, both by emigrants by the way of the Missouri and from California. Already is activity infused into every branch of business, and the prospect for the future are flattering in the extreme. Two weekly papers are published in this region, at Walla-Walla the Statesman, and at Lewiston the Golden Age; schools, academies, and churches, already rear their heads, and the great number of books purchased and papers subscribed to bespeak the intelligence of the people. Every nationality, from John Chinaman to the Englishman, and every State in the Union, are here represented; but notwithstanding the variety of languages spoken and views entertained, harmony in council and uniformity in action as yet pervade and mark the body politic.

CATHOLIC MISSIONS.

The Jesuit Catholic fathers have three missions established along the line of the road; one among the Cœur d'Alénes, one among the Pend d'Oreilles and Flatheads, and one among the Blackfeet. The first site of the Cœur d'Aléne mission was in the St. Joseph's valley; but the overflow of the stream and the many difficulties to which they were subjected at this point compelled them, in 1846, to abandon it in favor of its present site on the Cœur d'Aléne river. They have erected here a fine church, dwellings, and such other buildings as are necessary for their wants; the Indians are educated not only to worship God, but every attention is given to teach them to till the soil. The missions use Indian labor exclusively, under the direction of three lay-brothers, and are supported from a small fund for the "propagation of the Catholic faith," which is devoted exclusively to the purchase of those articles which they themselves cannot produce or make. They are thrifty and frugal, and by their zeal in the cause and devotion to the best interests of the Indians, for whom they have given their lives a voluntary offering, they wield an influence among the better portion such as no whites or government agents have ever been enabled to obtain. Far removed, as yet, from contact with civilization, their lives of upright moral rectitude, zeal in behalf of the Indian, their morning, noon, and night devotion, when all the tribes assemble and chant pæans to the Almighty, the perfect harmony that exists in their social family of Indians and half-breeds, has ever won my highest admiration. In all that tended towards the ultimate success of my movements I have ever enjoyed their kind co-operation and zealous support, and during the many years spent near their mountain homes the kindest and warmest relations have ever existed between us.

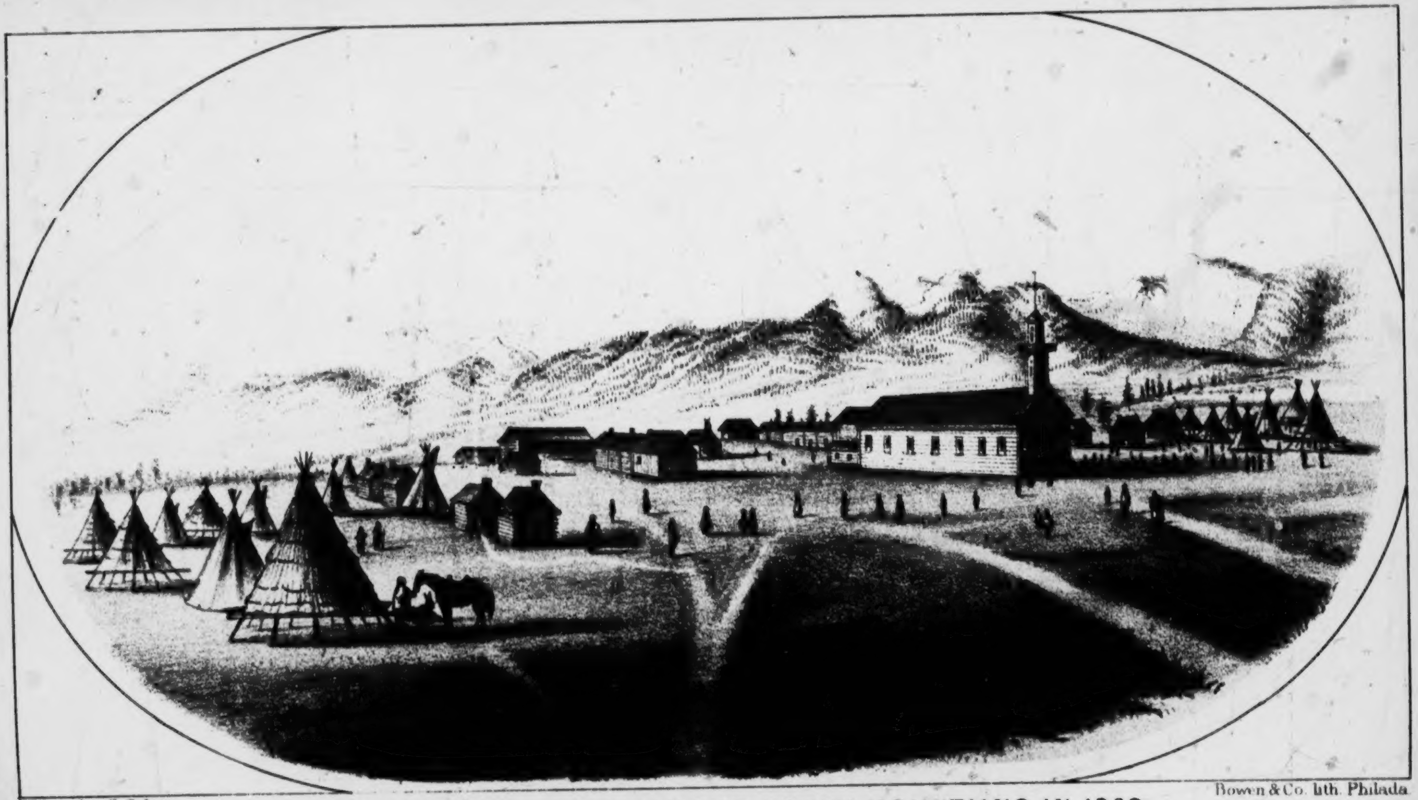
The fathers, in abiding among the red men, have but one object in view: to rescue them from the blighting effects of ignorance and superstition, and to reclaim them from the effects of an advancing civilization, which to them is death. I can only regret that the results as yet obtained would not seem commensurate with the endeavors so manfully put forth. The only good, however, that I have ever seen effected among these people has been due to the exertions of these Catholic missionaries.

Many of these missions might be benefited by the government allowing them the charge of the schools and hospitals, for they actually take care of the Indians when sick and educate them when well, and all this with the mere pittance at their disposal, not a moiety of what they need; while hundreds and thousands are squandered on paper for the benefit of the Indians, and which they never receive.

The Cœur d'Aléne mission has the Fathers Josét and Gazzoli, and Brothers Francis, McGuire, and Campapiano. They have chosen a beautiful site, on a hill in the middle of the mission valley, and it has always proved to the weary traveller and destitute emigrant a St. Bernard in the Cœur d'Aléne mountains. I fear that the location of our road, and the swarms of miners and emigrants that must pass here year after year, will so militate against the best interests of the mission that its present site will have to be changed or abandoned. This, for themselves and the Indians, is to be regretted; but I can only regard it as the inevitable result of opening and settling the country. I have seen enough of Indians to convince me of this fact, that they can never exist in contact with the whites; and their only salvation is to be removed far, far from their presence. But they have been removed so often that there seems now no place left for their further migration; the waves of civilization have invaded their homes from both oceans, driving them year after year towards the Rocky Mountains; and now that we propose to invade these mountain solitudes, to wrest from them their hidden wealth, where under heavens can the Indians go? And may we not expect to see these people make one desperate struggle in the fastnesses of the Rocky Mountains for the maintenance of their last homes and the preservation of their lives. It is a matter that but too strongly commends itself to the early and considerate attention of the general government. The Indian is destined to disappear before the white man, and the only question is, how it may best be done, and his disappearance from our midst tempered with those elements calculated to produce to himself the least amount of suffering, and to us the least amount of cost.

The Pend d'Oreille mission is pleasantly situated on Mission creek, a few miles to the north of the Jocko reservation, where Fathers Minetry, Louis Vera Cruz, and Grisi preside, with two lay-brothers. They have here, as at the Cœur d'Aléne mission, a complete set of buildings for their residences and a beautiful church; here, too, Indian labor is employed. The original site of this mission was on the Clark's Fork, about fifty miles from Fort Colville, where the lower Pend d'Oreille Indians lived; but, finding at this point more soil to cultivate and a better site, they removed hither in 1855, bringing many of the lower Pend d'Oreilles with them. They have, besides, a branch mission at Fort Colville, visited from time to time by Father Josét. They had a mission at the present site of Fort Owen till 1850, when it was abandoned and the property sold to Major John Owen, where he now resides, having a pleasant home, and the finest library I have seen on the north Pacific coast.

The next mission is among the Blackfeet; but as yet not much headway has been made towards its permanent establishment. The fathers chose a site on



Drawn by C. Sohon.

PEND D'OREILLE MISSION IN THE ROCKY MOUNTAINS IN 1862.

Bowen & Co. lith. Philada.

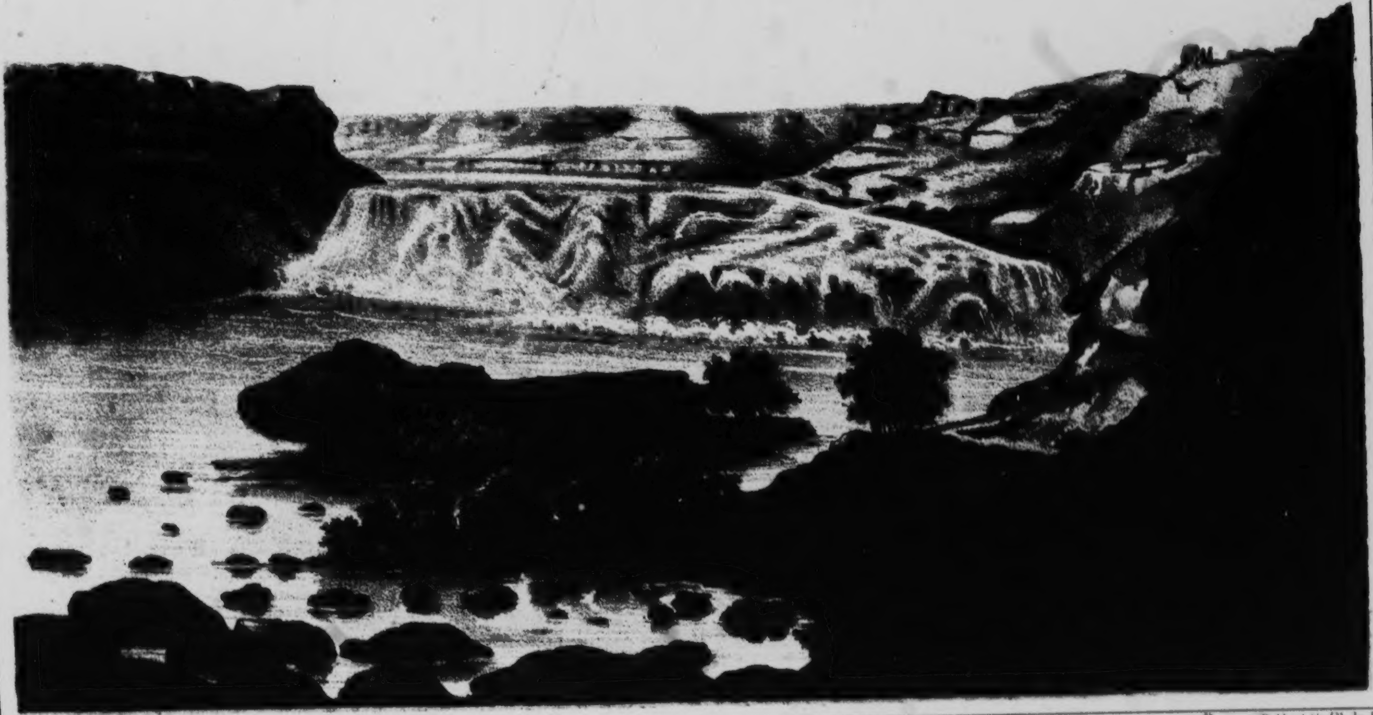
Sun river, ten miles above the wagon road crossing, where they erected a few buildings; but they never enclosed fields, and last year it was abandoned. They then held service at, and occupied the site of, Old Fort Campbell, a mile above Fort Benton. While I was at this point last summer they were projecting a site on the Marias with a view to there establish their permanent homes; the extent of good soil, its mild climate, its proximity to the homes of the Blackfeet, and its distance from the line of travel, all combining to determine them in its selection. At present the superior is Father Giorda, who has his headquarters at Fort Benton. The superior for many years while I was in the mountains was Father Congiato, from whom I have received many kindnesses and courtesies; but he being assigned to the presidency of one of the colleges at San Francisco, compelled a change. Fathers Imoda and Giorda, with two lay-brothers, are at the Blackfeet mission. The country and the Indians are mainly indebted to the zealous labor of the Reverend Father de Smet in establishing all these missions, for he truly is the great father of all Rocky Mountain missionaries. By his travels and his labors, and the dedication of his years to this noble task, he has left a name in the mountains revered by all who knew him, and a household god with every Indian who respects the black gown. His early work, called the "Oregon Missions," is replete with interesting information, and from which we ourselves have collected many geographical and statistical facts. To him and his colaborers in their self-sacrificing work I return my thanks for their many kindnesses, with the hope that they may live to see the full fruits of their zeal and toil amid the fastnesses and solitudes of the Rocky Mountains.

CLIMATE, SNOW AND COLD.

There has been no one subject so little understood or so much misrepresented as the climate of the northern valleys of the Rocky Mountains and the plains extending to their either base. I am frank to admit that the section of our road from the Cœur d'Aléne mission to the Bitter Root ferry does interpose the obstruction of snow to such an extent that I despair of seeing it travelled in winter unless a daily mail coach is placed upon the line, when the snow being beaten down twice a day, would, I think, keep the line constantly open. But all the remaining sections are mild, with so little snow that travelling with horses can be kept up all winter. And although the climate in the region first referred to is severe, by going north to the Clark's Fork, we at once enter a milder section, and one that offers every advantage to travel. The temperature of Walla-Walla, in 46°, is similar to that of Washington city, in 38° latitude; that of the Clark's Fork, in 48°, to that of St. Joseph's, Missouri, in latitude 41°; that of the Bitter Root valley, in 46°, is similar to that of Philadelphia, in latitude 40°, with about the same amount of snow, and with the exception of a few days of intense cold, about the same average temperature. This condition of facts is not accidental, but arises from the truths of meteorological laws that are as unvarying as they are wonderful and useful. As early as the winter of 1853, which I spent in these mountains, my attention was called to the mild open region lying between the Deer Lodge valley and Fort Laramie, where the buffalo roamed in millions through the winter, and which during that season constituted the great hunting grounds of the Crows, Blackfeet, and other mountain tribes. Upon investigating the peculiarities of the country, I learned from the Indians, and afterwards confirmed by my own explorations, the fact of the existence of an infinite number of hot springs at the headwaters of the Missouri, Columbia, and Yellowstone rivers, and that hot geysers, similar to those of California, existed at the head of the Yellowstone; that this line of hot springs was traced to the Big Horn, where a coal-oil spring, similar in all respects to those worked in west Pennsylvania and Ohio, exists, and where I am sanguine in believing that the whole country is underlaid with immense coal fields. Here, then, was a feature sufficient to create great modifications of climate, not local in its effect, but which even extends for several hundred miles from the Red Buttes, on the Platte, to the plains of the Columbia. The meteorological statistics collected during a great number of years have enabled us to trace an isochimenal line across the continent, from St. Joseph's, Missouri, to the Pacific; and the direction taken by this line is wonderful and worthy the most important attention in all future legislation that looks towards the travel and settlement of this country. This line, which leaves St. Joseph's in latitude 40°, follows the general line of the Platte to Fort Laramie, where, from newly introduced causes, it tends northwestwardly, between the Wind River chain and the Black Hills, crossing the summit of the Rocky Mountains in latitude 47°; showing that in the interval from St. Joseph's it had gained six degrees of latitude. Tracing it still further westward it goes as high as 48°, and develops itself in a fan-like shape in the plains of the Columbia. From Fort Laramie to the Clark's Fork, I call this an atmospheric river of heat, varying in width from one to one hundred miles. On its either side, north and south, are walls of cold air, and which are so clearly perceptible, that you always detect when you are upon its shores.

It would seem natural that the large volume of air in motion between the Wind River chain and the Black Hills must receive a certain amount of heat as it passes over the line of hot boiling springs here found, which, added to the great heat evolved from the large volumes of water here existing, which is constantly cumulative, must all tend to modify its temperature to the extent that the thermometer detects. The prevalent direction of the winds, the physical face of the country, its altitude, and the large volume of water, all, doubtless, enter to create this modification; but from whatsoever cause it arises, it exists as a fact that must for all time enter as an element worthy of every attention in lines of travel and communication from the eastern plains to the north Pacific. A comparison of the altitude of the South Pass, with the country on its every side, with Mullan's Pass, further to the north, may be useful in this connexion. The South Pass has an altitude of seven thousand four hundred and eighty-nine feet above the level of the sea. The Wind River chain, to its north, rises till it attains, at Frémont's Peak, an elevation of thirteen thousand five hundred and seventy feet, while to the north the mountains increase in altitude till they attain, at Long's Peak, an elevation of fifteen thousand feet; while the plains to the east have an elevation of six thousand feet, and the mountains to the west, forming the east rim of the great basin, have an elevation of eight thousand two hundred and thirty-four feet, and the country between it and the South Pass an elevation of six thousand and two hundred and thirty-four feet above the level of the sea. The highest point on the road in the summit line at Mullan's Pass has an elevation of six thousand feet, which is lower by fourteen hundred and eighty-nine feet than the South Pass, and allowing what we find to be here the case, viz: two hundred and eighty feet of altitude for each degree of temperature, we see that Mullan's Pass enjoys six degrees of milder temperature, due to this difference of altitude alone. At the South Pass are many high snow peaks, as Frémont's Peak, Three Tetons, Laramie Peak, Long's Peak, and others, all of which must tend to modify the temperature; whereas, to the north we have no high snow peaks, but the mountains have a general elevation of from five to eight thousand feet above the level of the sea, and of most marked uniformity in point of altitude.

The high range of the Wind River chain stands as a curvilinear wall to deflect and direct the currents of the atmosphere as they sweep across the continent. (By-the-bye, whence arises the name of the Wind River chain?) All their slopes are well located to reflect back the direct rays of the heat of the sun to the valleys that lay at their bases. These valleys, already warm by virtue of the hot springs existing among them, receive this accumulative heat, which, driven by



Drawn by C. Sohon

GREAT FALLS OF THE MISSOURI, 2500 MILES FROM S^T LOUIS.

Bowen & Co lith Philada

the new currents of cold air from the plains, rises and moves onward in the form of a river towards the valleys of the Rocky Mountains, where it joins the milder current from the Pacific and diffuses over the whole region a mild, healthy, invigorating, and useful climate.

PRESENT WANTS OF THE COUNTRY.

The results of our long explorations in the country have developed the following results, to which the attention of Congress should be especially invited, and which, if met in the liberal spirit they so well merit, will redound to the best interests of the government by testing, to the fullest extent, the golden resources of the Rocky Mountain region, and which, standing, as they do, midway between the Mississippi and Pacific, will develop a bond of union and strength between the extreme sections of the continent.

These are to establish a military depot at the head of the great falls of the Missouri, at the mouth of Sun river, with a three company cavalry post; this depot to supply a four company cavalry post at the Deer Lodge, and a one company post at Hell's Gate. In this region are near fifteen thousand Indians, and these posts are needed to guard the emigrant lines that here fork, and over which travel will pass every season, as well as to protect the hundreds of miners and farmers there found. The supplies for all these points should be shipped from St. Louis by steamers direct to the falls of Missouri. These posts can be economically maintained and are a military necessity for the country. The military post at Walla-Walla should be reduced to a depot and its troops moved to Fort Boisé. One company should be posted at Florence, on the Salmon river; one at Oro Fino, and one company either at the Cœur d'Aléne mission or at Park's crossing, on the Clark's Fork. Four companies should be stationed at Fort Hall and the military post at Fort Laramie retained with a large garrison. These are all needed for the protection of overland emigrants. The supplies for all these points, except the latter, should come from Walla-Walla. Military roads should be opened from Deer Lodge to Salt Lake, from Fort Benton to Beaver Head valley, and from Beaver Head valley to Salmon river or to Florence.

The entire mountain region, from the Salmon river mountains to the plains at the head of the Platte, should be explored, mapped, and reported upon, and a short and direct connexion opened between Fort Laramie and the Salmon river gold mines, as it may be found that the shortest and best route for a Pacific railroad to the Columbia may be found from the Platte, *via* Salmon river, to Walla-Walla; at any rate, it is well worthy a special examination. The government should also test the capabilities of the upper Missouri and Yellowstone for steam navigation both for national purposes and as aids to the building of the Pacific railroad.

The Indians should be concentrated as much as possible and a Rocky Mountain superintendency established, with its headquarters either in Deer Lodge or in Beaver Head valley, and should include the Crows, Blackfeet, Snakes, Bonnacks, Flatheads, Pend d'Oreilles, Kootenays, and the mountain Nez Percés.

A Columbia river superintendency should be established, with its headquarters at Walla-Walla, and to include all the Indians between the Rocky and Cascade range, from the 49th parallel to Utah, both in Oregon and Washington.

Mail facilities should be established from Hell's Gate to Fort Benton, and from Deer Lodge to Fort Laramie and Salt Lake, also from Beaver Head valley to Florence City. A new military department of Oregon and Washington should be established, with its headquarters at Walla-Walla; a first-class military road should be opened from Wallula to Puget Sound; Portland, Puget Sound, and Salt Lake should be connected by a military telegraph; a new territory should be established east of the Cascade mountains, and a detailed map of its topography at once made by the General Land Office. A branch mint should be established either at Walla-Walla or Portland.

RAILROAD DATA.

One of the principal objects looked forward to in the completion of our road was the collecting of such railroad statistics and data as would definitely determine the location of a railroad line that, starting from St. Paul's, Minnesota, would reach the Pacific *via* the valley of the Columbia. At an early date of our work we gave attention to this subject to the extent of running a line of levels from the Dalles to the mouth of the Snake river, of a similar line through the Cœur d'Aléne mountains from the mission to Hell's Gate, and again a similar line through the main chain of the Rocky Mountains from the mouth of Lander's Fork to the Dearborn river. The results of each of these operations are fully contained in the sub-reports hereunto attached.

In the report submitted to Congress by the late ex-Governor I. I. Stevens a line *via* the Big Blackfoot and Cœur d'Aléne valleys was favored. But with all due respect for the judgment of this worthy man, and the opinion entertained by him, I am convinced that, had he known that the element of snow existed on these two lines to the great extent that we found it by a three winters' experience, this judgment would have been reversed, and he would have selected the line that I here advocate as the best—from the plains of the Missouri to the plains of the Columbia. It must be remembered that Governor Stevens examined this line in the autumn of 1853, and re-examined it in the summer of 1855. What is herein stated in regard to the wagon road, as regards meteorological data, applies with equal force to a railroad, and when the data collected by Governor Stevens were limited exclusively to the summer and autumn months, it is impossible for him to express what condition these two lines would be in during the winter. There is no doubt that the line he proposes would cause a great saving in distance, probably two hundred miles, over the one I favor, but it is a question whether this snow blockade, which would continue for five months of every year, might not require so great a length of time for its construction, and so increase the difficulties of running after it was built, to say nothing of the heavy expense of the necessary Blackfoot and Cœur d'Aléne tunnels, as should cause it to be selected in preference to one where the climate will enable you to work every month of the year, as well as run it when built, that passes through a country capable of settlement, and where the snow does not interfere with crops either in autumn or spring. The Cadotte's Pass, at the head of the Big Blackfoot, which has been described as preferable to the Lewis and Clark's Pass for a railroad line, would involve a two-mile tunnel, and the Cœur d'Aléne Pass would require one also of two miles, made at an elevation of four thousand feet above the level of the sea. A railroad line through each of these tunnels has an admirable and practicable connexion with the plains of the Missouri to the north of Fort Benton and the plains of the Columbia, *via* the Spokane river, but, in my judgment, an insurmountable objection to the location and running of a railroad here exists in the deep snow to which this especial section is subject.

Those who have carefully read the foregoing pages will not fail to remark that we discover a climate, *via* the Hell's Gate and Clark's Fork route, so mild and favorable to winter travel that a meteorological paradox would seem to hold in this especial quarter. I have noticed this so often, and so often taken advantage of it, that I have been disposed to regard the question of snow in this quarter as the all determining element in the location of a Pacific railroad northward through the Rocky Mountain section.

My own idea, therefore, if the line from St. Paul, Minnesota, is to be built, would be, when it had reached the plains north of Fort Benton, that it should hug the Missouri closely by the bluffs to its north, and thence follow the general line of the river to the Three Forks, thence follow up the valley of the Jefferson Fork and cross the main range of the Rocky Mountains to the Deer Lodge valley, and thence follow the Hell's Gate to the Hell's Gate ronde; here cross over to the Clark's Fork, *via* the Jocko river, and follow down this fork on its right bank to the lower end of the Pend d'Oreille lake; thence to the Spokane, and thence to the mouth of Snake river; from thence down the Columbia to the mouth of the Cowlitz, whence a branch line can easily be adjusted to Puget Sound. This line, by the direction herein given, would be 1,984 miles long and say three hundred miles longer than the route proposed by Governor Stevens; but when it is remembered that the route I here propose involves no tunnels; that it follows a continuous line of watercourses; that it will never be obstructed by snow, so calculated to lengthen the time of building, and to increase the difficulties of running it when built; that it traverses a region capable of settlement; that it taps all the mining regions where way travel is destined to be built up, and, moreover, passes along the navigable stretches of the Missouri, Clark's Fork, and Columbia rivers, essential and economical aids in the first construction of the road, truly it seems not too much to say, that this line may be regarded as subserving more advantages than any yet examined in the Rocky Mountains north of the 42° of northern latitude.

This line, when traced upon the maps, will show such a short distance between Fort Laramie and the Beaver Head valley, through which last point it passes, that it at once raises the question whether the main trunk railroad from the Missouri to California could not advantageously supply a branch deflecting at Fort Laramie, and thus—since the one is a necessity destined to be met—save a distance of not less than seven hundred miles in railroad construction. I would say, yes, provided the face of the country intervening between Laramie and Deer Lodge valley is feasible. With regard to this, we have not, as yet, a published official statistical report of heights to guide our judgment; for myself, I am convinced that we are to have a main trunk railway through the South Pass to California. This was imperative when California alone sent us her golden wealth, and when her protection was an argument sufficient to initiate this gigantic scheme. But when this wealth has been added to by that of Nevada, Utah, and Colorado, lying directly upon the proposed road, it becomes only a matter of time when the work shall be taken in hand, which, from its admirable connexion with the system of railways east of the Mississippi, must eventually supply Kansas, Colorado, Utah, Nevada, and California, that desideratum so much demanded during the last three years.

This fact brings us to the question whether the interests of Oregon and Washington would not be the better subserved by having a branch line from the main trunk extended from Salt Lake to the Columbia, and thus save hundreds of miles of new and unproductive construction, and avoid all the contingencies which climate and length of route would involve. This last matter, however, is one for the legislature alone to determine; but for the benefit of the engineer I would state that the northern line herein indicated is admirably practicable, and following, as it does, upon the continuous navigable stretches of the Missouri and Columbia rivers, it enjoys advantages for rapid and economical construction possessed by none others. In this connexion my attention has been forcibly drawn to the remark of the late General Lander, who, in discussing the Pacific railroad question, states:

"A preliminary railroad across the continent is all essential to aid the construction of the more permanent road demanded by the wants of the country, and any railroad contemplated must have this problem solved."

The first remark is forcibly true; but is it not reasonable to suppose that large and navigable streams, that already exist along the proposed lines, will not better, cheaper, and more abundantly supply all the wants of a first construction or preliminary railroad, built at an estimated cost of $50,000,000, and which, according to Mr. Lander's own idea, is to be considered so much dead capital, from which no remunerative interest can possibly accrue?

This idea of a preliminary road was ever a favorite scheme with General Lander as an aid to build the permanent road. This was natural as well as necessary, because along the line he advocated there was no navigable stream which could supply its place; had there been, the keen perception of so good an engineer would not have failed to discover the inestimable advantages of so good a natural substitute.

For myself, I have never ceased to place special stress upon the advantages presented by the Columbia and Missouri rivers, navigable, as they are, to their sources in the Rocky Mountains, and within a few miles of interlocking with each other, thus offering every facility for the rapid and cheap construction of a road along their borders.

Supposing, therefore, it is determined to build a railroad from Breckinridge, on the west border of Minnesota, to Puget Sound, the line herein indicated would, upon a detailed survey, be found to possess advantages so marked in their nature that it might be safe to assume that this will yet prove the approximate line of location for a northern route. In the following estimate which I append I have been guided chiefly by those made by Governor Stevens in his report to Congress, and which I have ever regarded as the most reliable yet made for that line, and therefore I have felt at liberty to use his figures, as well as the reasons that govern him therein, and the special views of location accompanying the same:

	Miles.	Cost per mile.	Total cost.
Breckinridge to crossing of Milk river	712	$40,000	$28,480,000
Crossing of Milk river to point of departure from Box Elder creek	30	40,000	1,200,000
Thence to Fort Benton	51.5	80,000	4,120,000
Fort Benton to Jefferson Fork	238.5	50,000	11,925,000
Jefferson Fork to Hell's Gate	150	60,000	9,000,000
Hell's Gate, *via* Jocko, to Clark's Fork	40	60,000	2,400,000
Clark's Fork, at mouth of Jocko, to the Pend d'Oreille lake	120	50,000	6,000,000
Pend d'Oreille lake to the Spokane	50	60,000	3,000,000
Spokane to the mouth of Snake river	190	60,000	11,400,000
Mouth of Snake river to the Dalles	150	45,000	6,750,000
Dalles to mouth of the Cowlitz	180	45,000	8,100,000
Cowlitz to Seattle, on Puget Sound	82	50,000	4,100,000
Steamers on Columbia and Missouri rivers			1,500,000
Reservoirs and aqueducts			2,000,000
Depots and permanent fixtures			1,750,000
Engineering and contingencies			5,000,000
Total cost from Breckinridge to Puget Sound	1,984		106,725,000

The foregoing constitutes the cost of building a road by the route which, after a study of several years, I have thought to be the best in the range, and which is eminently a route *via* the Columbia and Missouri river valleys; even now it would pass through an interesting gold mining region, in addition to subserving the many advantages before referred to. If the future should determine that the interests of eastern Oregon and Washington are of such a character that a line must be had in their midst, and that this want would be felt before the northern Pacific railroad should be initiated, then by all means, I say, let a road be built along Snake river that will supply the Burnt river, Powder river, Grand Ronde river, and Boisé river mines in Oregon, and the Salmon river in Washington Territory.

As yet no perfectly reliable instrumental data have been brought in from this line; in fact, no government party was ever sent out to explore this region, except that of Colonel Frémont, but it may be assumed that the most authentic railroad facts yet obtained upon it were those of the late General F. W. Lander in his trip from Puget Sound to the Missouri in the spring of 1854, and from his report I have gathered such reliable data as will guide future parties in making a more detailed survey in this region.

The report of General Lander treats of the railroad question in the light of practicability, cost, mode of construction, and mode of payment while being constructed, and contains so many just views and criticisms on the subject that I have incorporated many of his ideas in my report.

It would be safe to say that no continuous instrumental survey has ever taken place in any of the proposed lines for a Pacific railroad; but what has been done on all of them might justly and simply be termed reconnaissances of routes; for, as General Lander says:

"Explorations of the wild interior, for the purpose of ascertaining the most economical and practicable route for a railroad to the Pacific, are reconnaissances rather than surveys. They are engineering studies of routes or belts of country, often of two hundred miles in breadth, of two thousand miles in length, extending from the verge of the eastern border to the Pacific, of which the characteristics are to be known regarding railroad construction." Routes are not lines; several lines might occupy relative positions on a single route. The lineal section, rapidly placed by the labors of a single season, and presented as the result of a Pacific railroad exploration, must not always be presumed to be a profile of the preferable, or the very best trace for location existing upon the division examined. From the limited time prescribed for making these examinations, and from the vast extent of country explored, the first line of barometric levels does not always occupy the best position of the route to which applied. The engineering features of the whole broad division passed over are connected with this base line, and stated in the form of opinions or convictions formed upon the mind of the engineer by former experience of the necessities of location in all varieties of country. The study of reconnaissance is not, however, confined to single divisions. In its broadest application, it compares routes rather than lines, states their relative merits, and by a simplified system of hurried field service, restricts the costly and tedious labors of elaborate instrumental survey to the preferable division; and, even upon that division, to a limited section of service. Thus distinct knowledge of extreme, or nearly impracticable obstacles, upon routes involving deep national interests—the existence of which may lead to the abandonment or neglect of important termini, or to the repeated and expensive application of instrumental survey to solve what nature made insurmountable—directs the attention of reconnaissance beyond the narrow limits of sectional location. And as reconnaissance directs reconnaissance; as the labors of survey are pursued as its results, and are involved and tedious in their deferred conclusions, the developments of the first important service cannot be too speedily continued to their limit when tending to prevent more costly expenditure by anticipating proposed surveys by additional information, which changes their direction. In all reconnaissances of location for the selection of the route or the line of a route of a railroad, some requisition to be answered must be present in the mind of the engineer. The interrogation, For what am I here seeking? should be evident to his senses and aid his study. There are different classes of railroads; different plans of construction. In the selection of the route of a railroad to the Pacific, the requisition as to the class of line to be adopted, and the plan of construction to be attempted, is the first and salient feature of the whole question. This unsolved problem in engineering is dissimilar from that of any road hitherto completed. It is, nevertheless, a problem to which one system of construction is more particularly applicable than any other; the physical obstacles to be overcome are in no degree to be deemed subjects of consideration, as compared with the practical difficulties which conspire to prevent its ready solution. The opinions of professional parties on this question, which are the result of experience in railroad-building, should meet the direct notice of legislation. If it can be readily demonstrated that the selection of the class of line which will best solve the present urgent necessities of this nation for rapid and effective means of overland communication restricts the whole question to the selection of a route or routes over which such a class of line or mode of building can alone be attempted, then the choice of these routes should not be made subordinate to any other consideration. It is not yet particularly known that a wagon road, a rough, rapidly extended railroad, suited to military and mail transportation, and an elaborately completed, thoroughly equipped Grand Trunk railroad, can each exist in their turn, as called for by the necessities of civilization, and each aid as successive steps towards the consummation of the legitimate object required. The wagon road and the rough railroad come within the limits of discussion of constitutional legislation; and if deemed expedient, would progress together. But the Grand Trunk road, if viewed only in legislation as the development of a requisition beyond the reach of constitutional aid, would alone appear as the result of the efforts of private parties to procure remuneration to a patriotic and commendable enterprise by the carrying trade of western commerce.

REVIEW OF THE PACIFIC RAILROAD PROJECT.

It is now nearly twenty years since the patriotic Whitney first advocated the construction of a railroad to the Pacific. He then asserted that, in working out the grand problem of self-government, this nation occupied a position to command the influx of that commerce of the Indies which had caused the prosperity of nations to ebb and flow like the waters of the sea over which it had been transported. He visited the principal cities of the Union. He addressed the legislatures of States and the houses of Congress. He spoke of the development of territory; of the march of a martial people towards the shores of the distant Pacific; of a great highway of nations existing through a line of flourishing settlement; of commerce and agriculture walking hand in hand; of the east and of the west united. He enforced these arguments with the full powers of a commanding intellect and by the expenditure of his private fortune. But he failed in receiving the support of congressional legislation; and as long lines of railway had never successfully competed with water transportation, private individuals declined this investment unless government aided it. Whitney went to England. He was received and noticed with honor. He addressed the British Parliament; but he was never able to achieve this grand purpose and glory of his existence. His patriotism and the devotion of his high nature only have their record in the present character of this great project, now fully before the people, and with which his name must forever remain connected. But the idea of a Grand Trunk railroad, elaborated from the very outset to the needs of an immense carrying trade, built in sections of one hundred miles, by a system of land grants, and existing by some act of intuition on the part of its well-wishers, over mountain ranges, mighty rivers, sterile deserts, and regions devoid of wood, building materials, and sources of supply, has never yet been surrendered. When the municipal land grants of Texas, held out as a bonus to capitalists, led to the creation of a mammoth company, and influenced the voice of the press, this idea of a Grand Trunk road was strenuously urged by eloquent advocates. It appeared in the glorious arguments of Benton. It still lies like an incubus on every effort made by professional parties to divest this national project of those objectionable features which have so long placed it in the light of a chimera and an experiment. While the whole question has changed in its character, and that feature—the idea of procuring the influx of western commerce to the United States of North America by building a Grank Trunk railroad across the continent, which for nearly twenty years barely elicited public notice, and failed of gaining the attention of congressional legislation—is no longer the leading, but has become the subordinate requisition of the problem, it is still allowed to weigh upon and embarrass the action of government. The claim of the Pacific coast to better means of overland communication, unexpectedly made prominent by the discovery of the gold fields of California, and the corresponding development of the Territories of Utah, Oregon, and Washington, was at once thought a necessity of such character that its solution could not be waived or postponed without vital injury to the best interests of the nation and to those important and isolated communities. For this reason, in the very first discussion of this new and striking feature of the question, many patriotic individuals proposed the extension of a wagon road. Others, in ignorance of the various classes of railways, advocated the immediate adoption of the grand plan of Whitney. It was urged by the latter that the great plains of the interior were already whitened by the bones of American emigration in the passage of a wagon road. The railroad of the Isthmus of Panama, extending through an unhealthy climate and over foreign soil, had been projected and carried to its completion by the impulse of American energy. With the aid of government this project might readily be completed by the enterprise of private individuals over our own territory, and by a route avoiding the fatal fevers of the south. Mails, troops, and munitions of war could be safely and rapidly transported, and the great travelling population of the east and west no longer be exposed to the dangers and inconveniences of the isthmus transit. But grave questions now came up for consideration. It was open for argument how far Congress might aid the speculative operations of private parties, save as the most direct step towards the legitimate consummation of a single object in view.

The united sovereignties which jointly possess the broad domain, extending from the east to the Pacific, would necessarily act with caution in entering the debatable ground of constitutional rights. The nation was then laboring under the results of a disastrous depression and derangement of the business relations of the country. This state of things had been produced by an unhealthy mania in railroad speculation, not only unrestricted, but in a measure urged forward by the indiscriminate patronage of local legislation. The unwieldy operations of companies under the management of interested private parties had not always been guided by the true spirit of patriotism. No argument of mere expediency should affect the action of goverment. In treating this question Congress, acting under constitutional limitation, could only continue to insure a perfect union, domestic tranquillity, and common defence, further the general welfare, regulate the land forces, provide for calling forth the militia to repel invasion, promote the progress of science and art, defend California against invasion, and, perhaps, by the extension of a post road, give to her citizens the privileges enjoyed by other sovereign States. No preference could be given, even by the establishment of a regulation of commerce, to one State over another; and it would require a power of discrimination, very difficult of application, to decide to which portion of the Union should accrue these supposed wonderful advantages in the development of a project claiming the aid of a government strictly bound to render exact and equal justice to all. It is well known that these questions were left to the consideration of Congress. The representatives of a people known to possess mechanical ingenuity and constructive faculty were called upon by the united voice of the nation to look this subject of overland communications boldly in the face; to view its manifold relations; to grapple with its great apparent difficulties, and, if constitutional, to decide when, where, and in what manner it could be best and most speedily accomplished. If it was denied that government had constitutional power to act in the premises, it certainly did not require argument to prove that those distant communities, the unparalleled development of which had been the growth of an epoch in the history of human progress, were an integral portion and a part of the republic; and it was also evident that they were entirely isolated and unprotected. By the Constitution Congress was compelled to defend California against aggression. It is well known, in these years of revolutions and counter-revolutions, that the United States of North America had become an object of suspicion and of dread to older and less progressive nations. In the event of war with one or more of the great powers of Europe, California could not be defended against aggression by the means then within the command of the general government. Troops, supplies, and munitions of war would be exposed to the dangers and costs of inadequate modes of transit, of a broken and interrupted water transportation, and to the passage of an unhealthy and, in that event, probably a hostile foreign territory. It had ever been the policy of this government to restrict the military operations of the country to a simple and effective character. Rallying the energetic population of every hill-side and prairie around that gallant and efficient military organization, which would compare in ability and attainment with that of any service of the earth, it was evident that the necessity of the occasion would require the rapid transportation of these suddenly collected forces to the utmost verge of her remotest border.

In view of the achievements of science and the mechanic arts, and the advanced stage of human progress in the nineteenth century, a military road could no longer be deemed the means of crossing a river or making passage of a hillside. In reference to the exigencies involved, it was the application of that mode of transit which had in a measure annihilated distance to a route of two thousand miles in length from the populous eastern States to California. It was the definite solution of the requisition of a new, unexpected, and striking necessity by the use of the best means at the command of the nation. The demand was immediate. If it was within the power of government to act in the premises at all, then when government should act on the question became evident to the weakest observer. If it was within the power of government to act in the premises at all, then where government should carry this project to early consummation grew out of the national requisition of military defence and those claims which had led to the attention of Congress. If it was within the power of government to act in the premises at all, then in what manner it could be best and most speedily accomplished would be devised by the wisdom of legislation, in order to avoid those misfortunes which, in the development of minor and local railroad projects, had affected the business relations of the country, and had been noticed by a message of the President; but the project was yet to be placed in a position to become the object of a fostering legislation; an undertaking which to aid would be national, and to achieve, patriotic. Unprofessional parties had invariably confounded the domestic and commercial relations of the problem with that distinct and salient constitutional feature which gave Congress power to act upon it. The question as to whether government could use the iron rail and locomotive engine in the extension of a post road over two thousand miles of uncivilized country, and that mode of transit which had in a measure annihilated distance, as a means of defending a distant sovereign State against aggression, permitting a proper regulation of the land forces, by rapidly transporting the suddenly organized forces of her volunteer soldiery to the distant, unprotected portions of her domain, whether or not a military road should still be considered that sort of structure which existed at the date of the Constitution, or be superseded by the triumph of human ingenuity, this question had been merged by legislation in an endeavor to answer the anticipation of private individuals, who sought to change a government of general and limited power into a party, speculating with the lands and funds of the people, by aiding an experimental endeavor to procure the influx of western commerce to some single State or section of the Union, perhaps to the detriment of all the rest. If, from want of professional information, the treatment of this subject has hitherto been reversed in its nature, and the need of the hardy pioneer of civilization has been merged in the claims of the capitalists of the eastern cities, it may readily be placed in a clear point of view.

DIFFERENT SYSTEMS OF RAILWAY CONSTRUCTION.

The plan of building a Pacific railroad, which has been so long presented, by extending it in sections of one hundred miles, elaborated from the outset to the full needs of the immense carrying trade of western commerce, and slowly verging towards the wild interior, is that of the English system of construction. Built on such a plan, by the use of credits, bonds, and mortgages, and by a brokerage over a basis of land grants, it would combine all the disadvantages of both the American and English modes of construction. These are very dissimilar. The English system, adopted in building the first roads of New England, has been modified in America to more expeditious and less costly methods of attaining the results required.

Although the Pacific problem is different from that of any road hitherto completed in civilized regions, it is nevertheless one to which the present American modes of building, divested of their objectionable features, are more particularly applicable than any other. It is that of the extension of a road over an uncivilized and, in many instances, uninhabitable country; and the American system is that of the rapid extension of lines, at low cost, over undeveloped and non-paying routes of transit. The Pacific railroad is to reach a terminus two thousand miles distant, from which a revenue is anticipated; but, until this anticipation of revenue is answered, must be restricted in development to the simple requirements of military and way transportation. The American system of building is one by which a line may pass through various stages of elaboration to any class or character required, even after the connexion of termini has been accomplished; for it is the great principle of the American "open construction account" that a road should not be placed under the serious liability of maximum equipment for service it may never be called upon to perform; but, if practicable, should be made to reach and develop the sources of future traffic, under the support of a way transportation at paying rates. From the operations of interested and unscrupulous speculators, often occupying the position of railroad directors, and gambling with the funds of stockholders committed to their charge, and especially in the building of short lines, where permanent construction should have been deemed expedient from the outset, the system of the open construction account has encountered great opposition, and has been unwarrantably assailed by unprofessional parties.

Under the present credit system—one of the evils of the American mode of building—from the necessities of brokerage and premiums, and the gambling liabilities borne by innocent stockholders, a mere percentage of the amount of margin presented as the cost of roads is devoted by the American constructing engineer to their actual working. This has been one of the chief reasons why the cost of American roads has so often exceeded their engineering estimates. Over twenty-five per cent. of the amount now invested in lines of the United States has proved a total loss to the original stockholders. The civil engineers of the country have very generally borne the odium of these liabilities, which is probably the reason why their opinions have such slight weight when brought to the consideration of this national undertaking. Yet this project is one to which the application of the American system of expansion will restrict the first liabilities of wear and tear, depreciation and deterioration, risk or loss of outlay, and all questionable expenditures, to the minimum, in the construction of a line which, from the length of route traversed before connexion can occur with a paying terminus, will not warrant first-class construction and equipment from the outset. It would require a period of twenty years to build such a grand road to the Pacific on the obsolete system proposed. During this space of time those portions of the road first completed would thrice need renewal as worn out and decayed. The amount of the cost of this renewal would absolutely construct and equip a road of medium class, with ordinary management, reaching the Pacific in ten years, and, if necessary, even in five years. This preliminary road would not make a passage of the same obstacles by reduction of surface, or adopt so direct a line, as a Grand Trunk road; but select a route giving the most rapid results to first outlay, by at once answering the present needs of the nation. It would also accomplish that first step towards the construction of a grand road, which would eventually insure its completion without great loss to its projectors, or, more properly, to the government finding means for extending it. A doubt exists in the minds of practical individuals whether the traffic of a Grand Trunk overland railroad will ever support its running expenses. Hence, there is an experiment to be tried. Government is not particularly interested in the question as to whether the commerce of the Pacific seas will pass over this line, when built, or continue to be borne by clipper-ships around the southern extremity of South America. Government is interested in the solution of the problem only so far as the results of the experiment tend towards the extension of a speedily-consummated and effectual means of overland mail and military transportation.

But while government will hesitate to exercise doubtful constitutional powers, and will practice due economy in the expenditure of the money of the people, it will, when not conflicting with those powers, seek to further all important domestic and commercial relations. While the idea of a Grand Trunk road must be treated with caution, because, so far as government has constitutional powers to act on the question, the choice merely lies between the use of the iron rail and of the wagon road, and it can be demonstrated that the use of the iron rail can take place prior to the completion of a grand road; yet, as regards the choice between the use of the iron rail and of the wagon road, the probability of the future construction of a Grand Trunk Pacific road should be brought into the discussion. The experiment as to whether the commerce of the west will pass over the American continent by railway, even when a railway is in operation, cannot be tried by the extension of a wagon road. But it can be practically tested by the extension of a railroad only suited to the absolute needs of military and way transportation. Again, should this experiment prove successful, then the Grand Trunk railroad of the present day would be wholly inadequate to the amount of transportation required. The broad, uncultivated wastes of the American continent (over any route whatever) are unlike the present railroad routes of civilized regions. They compare with them as the drear expanse of the ocean contrasts with the inland navigable waters of our lakes and rivers. When this sea of space is to be traversed with the certainty of a paying business, with no important way stations, and an enormous through traffic to warrant the running of trains, the locomotive engine will make passage of the level sand wastes of the wild interior at rates of speed which will startle human credulity. And when the same inventive genius which once so readily modified the costly modes of building of older nations to the means and demands of our own new and undeveloped country is called upon to grasp the broader conclusion, and solve this future necessity of civilization and of progress, then the Pacific railroad will resemble the present Grand Trunk road, of populated countries, as the new British steamship Great Eastern compares with the first class-steamer of the coast. Thus, while the first study of this question should be grounded on a comprehensive desire to answer at once and in the best manner, that which is at present required, yet, in view of the grand prospective contingencies presented, it should also be definitely guided by a full apprehension of that which is liable to occur. The conclusion is, that if government should see fit to construct a railroad, necessarily in connexion with, but in preference to, the extension of a wagon road, then a railroad, suited to military transportation; and to the mere testing of this experiment, is the class of road to be attempted. In this connexion, the assertion of the unprofessional observer, "That it is always cheapest in the end to build a good road first," must have no weight. A road suited to the needs of way and military transportation is necessarily a good road, and, built by the aid of government, should not be accepted, if of unstable or insufficient character. It is the choice of route, and nature of surface passed over, which reduces its cost and favors its rapid extension, and which is, in reality, the chief argument for its use in preference to the wagon road. But I will close this argument by asserting that no road of permanent works and substantial class can be built across the continent with only the use of a wagon road as a vehicle of transportation. The appliances of civilization and the materials of construction must be placed contiguous to the works by progression of settlements, or by the prior extension of a pioneer or preliminary railroad. But, although permanent works may be erected by awaiting the tardy progression of settlements through the fertile border country, they cannot thus be raised in the far interior. Long sections of all routes are there devoid of wood, stone, and every variety of building materials. Broad divisions are not susceptible of development by settlements, and can never become provision-producing districts. From the distance to be passed over, and the amount and speed of transportation required, labor can neither be supplied nor supported. Weighty materials cannot be moved over the hundreds of miles from where, existing in natural deposits, they must be furnished to sections deficient. Mules, oxen, and horses fail, break down, and die by scores, in making passage of those distant, sterile, and arid plains. The use of the iron rail and locomotive engine is that means of transit perfected by human ingenuity to the best practicable result for the moving of weighty materials at high rates of speed and at low cost. In fact, it cannot be denied that it fully transcends all other modes of land locomotion. These very routes where domestic animals can hardly be made of use, and where the supplies of human subsistence cannot be procured, can be readily developed by railway, by laying a rough superstructure on the natural surface of the earth, and thus the very best means of transportation can be supplied. The whole pecuniary question regarding the treatment of this project of a railroad to the Pacific resolves itself into the expenditure of the least amount of cash capital without reasonable prospect of remunerative return. The engineering question resolves itself into the obtaining of some rapid and effective means of transportation along the route of the grand road, that it may be constructed at all. The first relation is, the distance to be passed over before connexion can occur, with a paying terminus; and the second, the stupendous nature of the nearly insurmountable obstacles and practical difficulties which will serve to postpone the completion of any road of first class character. Both presentations of the subject are wholly subordinate to the great and immediate need of the Pacific coast, to the healthy overland military and mail transportation, which is the single constitutional requirement in the premises. This is a requisition which cannot be waived or postponed. A wagon road will not answer it, and a permanent railroad cannot be legislated towards the Pacific by the will of its well-wishers, under incomprehensive views of the difficulties attending its extension. Therefore, with a full sense of the importance of such an opinion, and a definite knowledge of at least two of the great routes across the American continent, I propose the extension of a rough American railway, of weighty superstructure, but of medium equipment, from the extreme western border of eastern civilization to the Pacific, as the exponent of that practical experience of the railroad-builders of America, which, if never officially called to the treatment of this public question, has shown such admirable results in the extension of lines through thinly populated regions, even when harassed by the unscrupulous management of speculative parties. I present it as a simple proportioning of means to the end required, and as a restriction of the undue expenditure of the money of the people in the solution of a national problem. For (returning to the first point of this argument) if, by the Constitution, Congress is compelled to defend California against aggression, and regarding the settled policy of this government, forts and standing armies are not deemed the preferable means of military defence; if, as is stated by the first military talent of the nation, California cannot be practically defended by the means at present within the disposal of government; if a wagon road is unsuited to the rapid transportation of weighty supplies, forces, and munitions of war; if the construction of a grand trunk railway is a ponderous and dangerous experiment, and its eventual completion beyond the limits of reasonable anticipation; if the iron rail and locomotive engine may be made of immediate use, and solve this necessity by the mere adoption of a route of transit over which it can be profitably extended, then the building of this railroad to the Pacific, applicable to the exigencies involved, the amount of transportation required, and the remuneration which will ensue, is a legitimate and warrantable undertaking, because no other will answer the purpose of the case proposed. It is the extension of a railroad of the least cost in the first outlay, because built through an uncivilized country, over an undeveloped route, and as subject to the contingency of total loss to its projectors, if elaborated beyond the stringent needs of the mere requirements of necessity, before reaching the distant terminus from which a revenue is anticipated; the extension of a railroad to solve the correctness of this anticipation of revenue, and, under the nature of an experiment, to test its value; but, beyond all these minor requisitions, the extension of such a railroad as the comprehension of other and more important national considerations will alone warrant constructing. It is, in like manner, the adoption of a route which, from the nature of the surface passed over, and from the avoidance of great obstacles, will lead to the immediate consummation of the project. If the use of the rail, prior to the actual completion of the road, by the mere selection of a route over which it can be extended by light grading, seems to the unprofessional observer impracticable and absurd, to the experienced railroad-builder, who has seen the working locomotive and material train made the grand vehicle of transportation over unfinished lines and upon every variety of surface, this mode of transit will at once sustain its important character in relation to the peculiar necessities of the present case. Over portions of that broad central divison of the continent, reaching from the Missouri river to the Pacific, the mountainous, broken, and undulating country bears a very small proportion to the extent of elevated plateaus, either level or of slight inclination to the horizon. These elevated plateaus offer substrata of sand or gravel, easily excavated, slightly affected by the action of frost, and, by nominal reduction of surface, affording a road-bed of perfect drainage, and of superior quality for the preservation of superstructure and machine, and also favoring those simple manual operations deemed sufficient to keep American railway lines in working order. A railroad line, passing over such a surface, would as far transcend all means of transportation by plank or wagon roads as is possible to conceive. It would admit a speed of twenty miles per hour, with loaded trains, over the greater portion of its distance, and at least the passage of loaded trains over all portions of its distance. It would appear as a direct exemplification of capital reserved. The whole amount of its cost would have been expended in the mere needs of transportation for the purpose of building the proposed grand trunk road. Attempted without its aid, the construction of the grand trunk road may be regarded a chimera; and even, if eventually completed, the depreciation and renewal of its superstructure and rolling stock, the loss of interest on dormant capital, and the disastrous results attending its consummation, would thrice exceed the entire cost of a preliminary road. The mere development of territory would remunerate the cost of constructing a road, only attempting in every stage of its completion a character or medium adapted to the simplest requirements of necessity, while no such minor sources of revenue would warrant the construction of a first class line or road assuming an elaborated character from the outset."

ROUTES.

"For a Pacific railroad, the term route will cover the extreme breadth of country to which side examinations may reasonably extend, or to which any claim of location may carry a line by detour. The term route in these remarks must not be confounded with the word line. The route of a line is, strictly defined by survey. The route to which the location of a line is referable is described by reconnaissance. Two of the grand routes across the American continent are peculiarly adapted to the ready and rapid extension of a rough preliminary railroad. One of these routes passes south of the Sierra Nevada mountain range, and in the vicinity of the Mexican frontier. The other is that of the present emigrant road of the South Pass to Cailfornia, Utah, and Oregon. Both of these lines are of flat plateau surface and gravel substrata. Over one of them the passage of trains would be obstructed during winter by the snow of the great plains; over the other, a northern population would be decimated during the summer by the fevers of the Gulf. Over one of them the frosts of the northern winter would, during half the year, prevent the speedy progression of the works of construction; over the other, the miasmas of a southern summer would prove fatal to the health of the Celtic laborer. Over the northern route pure water can be delivered from abundant sources of supply, at sufficient height above the rail, to be furnished at low cost for the use of locomotives; over the southern, it must be procured by more expensive methods, from fountains difficult of access and limited in quantity. The northern route is longer than the southern, but of central position; it can be more readily defended in time of war. Contiguous to provision and labor producing States, it can be more cheaply constructed, and, when built, will command and unite important and conflicting public and private interests. Long sections of both routes are destitute of timber, which only can be supplied by the use of the iron rail. Both of them differ from all other routes across the continents. Both are better suited to the speedy extension of an effective means of military transportation by railway than any others. Both are especially worthy the attention of government in the selection of the route of a road for the purposes of military defence; but neither of them would so readily attract the notice of speculators in land grants, nor is either particularly adapted to the development of great agricultural interests. As the salient requisition, which gives government constitutional power to act in the premises, is that of military defence, and the leading feature of that requisition is early communication, the first step towards the solution of this intricate problem of overland communication is narrowed down to the choice of one or both of these routes; the subordinate or latent characteristics which subsequently come forward in the domestic relations, of development of inland territory, and of procuring the influx of western commerce, not being confounded with, but in every respect kept distinct from, the peculiar and striking national feature which first won the attention, and is now strenuously urged as entitling this undertaking to the full notice of legislation. The most southern of these routes being beyond the field of the present report, I bring this whole view of the engineering merits of the question as giving great character to a forked road which, reaching by a main stem from the central border of eastern civilization to the Mormon settlements, would there permit of the connexion of a short branch line to Puget Sound, and of the extension of a main trunk to California. This road, as first extended, would represent the word line, as delineated, or placed by the requirements of location, by the trace of actual survey, for preliminary service. But, as eventually elaborated, it can only be described, at the present time, by the report of reconnaissance, as within the limits of all future claims of location by the word route. The rough road, built for the purpose of military transportation, must be placed, by engineering study, over a surface adapted to rapid extension, and be adjusted with great care at water crossings, summits of country, and all positions of a character to postpone early communication.

But it may, nevertheless, become the means of constructing a grand line, not necessarily contiguous to it, as the term would be applied in civilized regions; for, reaching by any line of approach, the vicinity of the plains and rim of the Great Basin, where occur sources of supply of iron, coal, building materials, and way stations of population, a preliminary road would become the carrying line for developing and transporting these resources. It is probable that John Charles Frémont is better qualified than any other individual to name the relative merits of the several lines of central routes, regarding agricultural development, from having compared them in the field. The direct line from St. Louis to San Francisco, which is located too far south to admit of ready connexion by a branch with Puget Sound and the important northwestern coast, is described by that distinguished explorer as possessing such characteristics. It has attracted national notice as a grand central Pacific line. Its adoption has been advocated by one of the oldest statesmen of America. And these desultory remarks are for the purpose of explaining that the combined extension of a wagon road and preliminary railroad over the present emigrant trail of the South Pass would in no degree prevent, but would, in fact, absolutely further, the completion of a grand highway of commerce and of nations over the direct line named, which, central in reference to commercial and domestic relations, is not central as regards the combined claims of California, Oregon, Washington, and Utah, or of the entire Pacific coast, for military defence, and, under the contingencies of rapid railroad construction, could not conscientiously be selected for such a purpose by legislation. This view of the question should also practically refer to all routes of such undulating and broken surface as to postpone early communication, if adopted. A military railroad should extend over plateau surface, from the mere fact that a railroad is not a line of fortifications, but a structure peculiarly pregnable to the most insignificant means of attack; and, when built over substrata of sand or gravel, the line of communication can be renewed, when broken, at a few hours' notice.

The energy of the American people has never yet failed to develop border country by railway. Legislation has seldom hesitated to aid the construction of roads, even in advance of the needs of civilization. But (summing up the statements of this paper) if nature has debarred any section of the continent those facilities of surface or positions which warrant the attempt at rapid railroad extension, in answering this grand necessity of the earliest practicable consummation of overland transportation, then the requirements of a whole nation should not be made subservient to such merely local claims to attention. If local roads can only tardily progress over a rich agricultural, but broken surface—a surface of excavation and embankment, of masonry and bridging, of practicable construction but of deferred communication—while the less costly preliminary line might be speedily extended towards the mountains, then the claims of the hardy pioneer of civilization, of the citizen of California, Utah, Oregon, and Washington, should not be deemed subordinate to the prayer of the wealthy capitalist of the eastern city.

If legislation is to furnish the means of solving this problem of overland communication, the rights of the poorest herdsman of the Pacific are as much entitled to notice as those of the eastern speculator in land grants."

THE CONSTRUCTION OF THAT FIRST SECTION OF A PACIFIC RAILROAD CONTIGUOUS TO THE STATES, THE INITIATIVE OR PRELIMINARY STEP TOWARDS THE EARLIEST PRACTICABLE CONSUMMATION OF THE WHOLE UNDERTAKING.

During the many long discussions which have taken place on the subject of a railroad to the Pacific it seems to have been forgotten, or to have entirely escaped notice, that all great railroad lines are built in sections, and that, although this road is one of two thousand (2,000) miles in length, yet but a single mile need be built at the outset. The argument that the difficulty of selecting a route prevents such a conclusion need not be entertained if the route is chosen on the constitutional grounds of the cheapest and earliest consummation of the military defence of the Pacific possessions by overland railways. If the whole question of the construction of a permanent road to the Pacific resolves itself into the prior construction of a railroad to the Pacific of less elaborated character, so, too, the construction of a preliminary railroad to the Pacific resolves itself into the building of the first mile of the very first section of the best route for that road adjacent to the border settlements. The first section of the main stem of the forked route of the emigrant road does not, however, commence at the first unfinished portion of the Pacific railroad (so called) of Iowa or Missouri.

The two hundred and fifty miles of severe undulating surface extending between these lines of rail, now tending west, and Missouri river, is of a character to prevent early completion; and the people of the Pacific coast and the present claims of the nation will not permit awaiting the three, four, or five years it will require to bring these roads to Missouri river. Neither can it commence at Fort Kearney, which is the proper point of intersection of all eastern lines. This point is as far inland toward the west, and wagon roads will not furnish the cheap and rapid transportation required for weighty materials of construction. From the peculiarity of surface offered—a surface graded and ballasted by the art of nature—the first section of the pioneer railroad of the emigrant plateau route must be supposed to commence on the Missouri river, near the mouth of the Platte. As the navigation of the Missouri as high as this point is ample for the transportation of rails, equipment, and furnishing the road—finding its own means of rapid extension—would reach the mountains, over the flat, sandy surface offered, at about the same period of time that the local roads of Iowa and Missouri were completed, to become its connecting links with eastern lines, say in three, four, or five years. The line (of five hundred (500) miles length) would traverse the edge of a range of low sand-hills, skirting a broad and fertile river valley, which reaches, without a break in surface, from the mouth of the Platte to the first broken country of the great grazing section of the Black Hills, (so called.) Under the present systen of legislation—the aiding of the extension of railroads by speculations based on the augmentation of the price of government lands to the actual settler—reasons might be offered why Congress can assist in the construction of this road of five hundred (500) miles on far more equitable grounds than have hitherto led to the multiplication of rivaling and competing roads across the border. The fact that this line would become the first section of a Pacific railroad, and the needs of California, Utah, Oregon and Washington find a place in a discussion which has hitherto been devoted to those of Texas, Arkansas, Missouri, Iowa, and Minnesota, or the wealthy capitalists of eastern cities, is probably the cause why this line could not thus be aided. The following domestic relations entitle it to notice, without reference to the fact that it would become a section of the Pacific railroad, viz: While other divisions of the public domain are favored by navigable waters, by which the appliances of civilization may be transported, the narrow belt of fertile soil which this line traverses can only be laid open to the pioneer by the passage of a railroad. Like many of the richest regions of the west, the country is sparsely wooded, and during the growth of wood, (by keeping out the prairie fires,) fuel and building timber cannot be transported for the use of settlers by the insufficient means of a wagon road. The needs of better means of transportation than this route now affords have become so great, that it has been proposed to secure them for the benefit of the Mormon settlements, by building a canal from the headwaters of the Yellowstone river towards Utah, and by a detour of over three thousand (3,000) miles of river and canal navigation. The construction of the road would shorten by five hundred (500) miles the distance now travelled by the overland emigration, and prevent the great loss to the nation in domestic stock which yearly occurs, and the value of which, thus saved, would pay the interest on the whole cost of building it. To secure the advantages of becoming the sources of supply to emigration, settlements would grow up at the mountain terminus of the line. These settlements would become some of the most important of the nation. They would soon furnish those supplies to transportation which, in event of war, would make the defence of the Pacific coast a practicable measure, by the further overland passage of trains by a wagon road. The citizens of a narrow State would defend and support their railroad. The border population, thus placed five hundred (500) miles nearer the Pacific, would soon reach the outlying farms of the Mormons. Intercourse would take place with that singular people, and the weight of public opinion tend towards solving an intricate problem in the science of self government. All these results can be obtained by the construction of a railroad at lower cost than any line now in operation in America of equal length. The road is on the grand approach to both the Bridger's Pass and the South Pass of the Rocky Mountains. It is the main trunk of the whole great overland travel going west of those mountains. It is most advantageously situated, regarding the connexion of eastern lines. At a point near Fort Kearney, at the head of Big Island of the Platte, roads from Lake Superior, from the pine districts of Minnesota, from Lake Michigan, at Chicago, from the central roads of Indiana, from St. Louis and the south, can favorably intersect with it on equal terms. These roads can there drain the traffic it has developed, and their trains make passage over it to the mountain terminus and the interior. The road would become, in its artificial relations to Kansas, Nebraska, and Utah, what the great rivers of our country have been in their natural advantages to the country east of the Mississippi; or, as all navigation ceases at the Missouri, a deficiency of nature would be supplied by the triumphs of human ingenuity; therefore, the general government might reasonably afford to aid the construction of this first section of a great railroad line in its passage towards the Pacific, where, full of important connexions, like the branches of a river, its arms extending upon either side, it would develop not only the narrow region which it traverses, but the resources of distant localities, and become to the western portion of the American continent what the Ohio and Mississippi have been to the eastern.

THE CREDIT SYSTEM OF CONSTRUCTION.

The construction of the pioneer or preliminary, rather than the permanent Grand Trunk road, will restrict the evils of this system to the minimum; and a mode in which the road might be built would, in a measure, prevent their occurrence. Without presuming to suggest to the attention of legislation the evils which, in my own belief, will inevitably follow the literal overworking of the land grant system of construction, when the stock market becomes flooded with the scrip of unfinished roads, I will refer to the credit system as connected with the subject of a railroad to the Pacific. Returning to the legitimate discussion of this question, I shall endeavor to maintain the position that even the construction of the first section of a Pacific railroad should not be made to labor under the liabilities of the land grant and credit system of building.

The conduct of the preliminary step in a series of experiments which shall test a great national project, and, in a measure, define its character, should be simple, effective, and guided by judicious deductions from former experience. The railroads of the United States are actually constructed by building contractors under the direction of civil engineers. These building contractors take the works from other contractors, who are great stock operators, and are often even directors of the company they bargain with. The companies are generally formed in the following manner: A very small amount of stock—say 30, 40, or 50 per cent. of that required—is raised by local parties along the route of the line. These parties (farmers, mechanics, merchants, and landholders) thus form the basis for the schemes and management of the operator, who takes the residue of the stock. Both company and operator are now at the mercy of the agents of the great capitalists of the country. By holding such amounts of stock, the operator in many instances controls the directors' board, or even changes it at his will, by the votes of proxy. When, by capital raised, borrowed, or furnished, the road is partly or wholly graded, it is then mortgaged or bonded for iron and equipment. The running of trains now takes place, and the road, now still in an incomplete state, is turned over to the company. About this period of time the able operator decides whether to dispose of or retain his interest in the line. A few years ago, when many of the lines of the country were first opened for travel, this plan of building occupied a very high place in public estimation; but since these roads have begun to wear, and the costs of renewal, of closing the open construction account, and of running trains at non-paying rates have opened the eyes of stockholders, it has, in a measure, fallen into disrepute. Very few of the roads of the country will now more than pay the interest on their bonds, the original stock subscription or basis being in most instances totally absorbed. But it is, nevertheless, undoubtedly true that the farmers, mechanics, and land-owners, who took the initiative and lost their original stock, are actually reimbursed by advantages gained. All sections traversed have been augmented in value, and, in the majority of cases, (always excepting the crises of monetary liabilities,) the country generally benefited. By the land grant system of credit construction, after small outlay the lands donated by governmemt become the basis of a borrowed capital, which is devoted to the extension of the road; the security given to government being the preliminary construction of a portion of the road. It is not necessary for me to describe a system so recently within the treatment of legislation. As applied to a Pacific railroad, its results would appear in the creation of a greater and more powerful monopoly than has ever yet affected the business relations of this nation. The placing of the rapid extension of this national road under the necessity of public appreciation, affecting and affected by the monetary transactions of the country, would tend to produce those crises in the stock market, to which the pecuniary affairs of our enterprising people have always been so peculiarly liable. But, without referring to these disasters, it is plain that if, during the progress of this road, public appreciation is once lost, all credit will be withheld, and a clear, simple, readily defined engineering problem will appear in the light of a false, visionary, and chimerical speculation.

The cause of the adoption of the old credit system of construction was from absolute poverty of means; the reason of the continuation of the great monopoly of the land grant system is because its evils are not yet sufficiently developed to be perfectly understood; but why either plan of building should be applied to retard the construction of a Pacific railroad I am at a loss to learn. If there is any power of the Constitution by which government can aid this undertaking on the grounds of military defence, neither poverty of means, nor any plea of expediency, conspires to place the project in a chimerical point of view, and no such course should be adopted to further the needs and desires of speculation. Dismissing the idea of the Grand Trunk road, which is an experiment, the subject of inquiry is, whether the pioneer or preliminary railroad shall be used for military defence in lieu of the wagon road To still further divest the project of chimerical features, a surface or route is sought where, by proper management, the use of the rail can take place without material cost in grading. The selection of such a route reduces deterioration without paying business to the minimum, and enables government to procure an approximate estimate of cost; or, more plainly, over either of the plateau routes of the continent a railroad can reach the Pacific in seven years. A road in common use needs renewal in superstructure and rolling stock in seven years; but the pioneer road having within this period of time reached the supposed paying business of the western terminus, a general through traffic would begin to balance wear and depreciation. Government is amply able to construct the road by cash payments.

The need of the nation is immediate. To place the undertaking under the liabilities of borrowing, and to subject it to the fluctuations of public estimation, is to retard it. To retard it when once commenced is, in a measure, to defeat it, or, at least, to indefinitely augment its cost. To create a moneyed monopoly, which will undoubtedly harass the stock market by an unrestricted paper issue, is to infringe upon the legitimate currency of the country, and has not hitherto been thought constitutional. We may, therefore, most certainly affirm that the land grant system should be applied to the Pacific railroad undertaking with great caution. As the very intricate and peculiar questions of loss of outlay by deterioration, and by working without revenue over a route of extreme length and novel character, may not yet be pefectly understood, I will once more allow myself to repeat conclusions offered. I distinctly state that if routes exist across the continent over which communication can ensue with a Pacific terminus in seven years, government should take no action to delay the communication beyond that period, but should aid the construction of roads over these routes only by cash payments. But as there are many other routes across the continent which are practicable, but, by passage of undulating surface, need excavation and embankments, bridge and culvert masonry, ballasting and drainage, before the rail can be made of use, and as these tedious operations (without reference to tunnels and mountain sections) will postpone communication, however attempted, government need not necessarily feel compelled to aid the construction of such lines by the direct application of cash capital. Hesitating to bear the risk of private experiments to procure the influx of western commerce over these lines, Congress might with reason sufficiently endow them against loss of running trains through undeveloped country, and against cost of renewal during their twenty years progression toward the Pacific. This aid, however, should duly be bestowed in sections; for, in the present instance, it is entirely out of place to endeavor to anticipate those contingencies of the future, which are in the course of solution by experiment, and which within ten years, or less, will be completely solved by the completion of the more rapidly extended preliminary lines. Having now placed this subject in every point of view of which I believe it capable, I will again refer to the construction of the first section of the preliminary road on the constitutional grounds of military defence.

HOW THE CASH SYSTEM OF CONSTRUCTION MIGHT BE APPLIED.

As this road is to be aided on the grounds of military defence, it is in some measure a government work. To favor the proper dispositions on Missouri river and along the route required for the purposes and supplies of military defence, it should be built under the direction or with the co-operation of military engineers. To secure the efficient management and able practical knowledge of private parties, it should be forwarded by contract.

The line of location of the route should be placed, from Missouri river to the mountains, by military engineers, to the furtherance of rapid extension, and not for the purposes of private border speculations by contractors. Iron rails and equipment should be deposited, by the water transportation of the Missouri river, at some point best favoring the most direct approach to the main Platte valley by light grading; this point should be selected by government engineers during preliminary arrangements; and the sources of supply of building and working materials should then be retained, from location of private parties, for the use of the road. The first section of five hundred (500) miles should be placed under contract requiring its completion within three (3) years from date. The expense of grading the road will be merely nominal, and is not sufficient security for advances by government. To require a very large deposit in money might embarrass the operations of the active parties (the real railroad-builders and mechanics) who should be called upon to construct this work by contract. From the favorable nature of the surface passed over, iron rails are necessary to the purposes of construction at the outset. As of high cost, and not liable to depreciation in value below a certain estimate, railroad iron should be regarded as equivalent to a deposit in bullion, and be accepted in lieu of moneyed security, or security by grading. A laid superstructure, capable of sustaining the tread of a first class locomotive engine at a speed of twenty (20) miles per hour, should be provided with simple working equipment, turn-outs, and watering stations before any payment is made to contractors. From the point on Missouri river to Fort Kearney, near Big Island of the Platte, the road might properly consist of the common (T) rail of 60 pounds per lineal yard, spiked to a wooden cross-tie, and extended over a ditched and drained road-bed of the clear gravel of the section. From this point of intersection of all eastern lines, (see sketch) near Big Island, a different class of structure might be attempted at the option of the engineer. Just beyond this point, the great untimbered section, reaching toward the Rocky Mountains, would be entered by the line. Government might make payments of $10,000 per mile for the first and for each succeeding one hundred (100) miles of road completed, if expedited to the satisfaction of the directing engineers. On reaching the western terminus of the first section of five hundred (500) miles, government to pay private parties such sums as shall have been agreed upon by the first contract, based on proposals issued, and thereon concluded with responsible bidders; government to reserve the right of cancelling the contract and taking possession of the road during progress of the work, upon equitable grounds or upon failure of contractor to perform obligations. Such a road sold at public auction would always guarantee first outlay. When completed (the first section) it would become the outlet and carrying line for the building of a Pacific railroad over any central route. It would, therefore, be readily accepted by private parties in lieu of further cash payments (beyond the first $10,000) by government. But, from its important position, this road should continue to be within the general control of legislation. As extended over the route of emigration, the building party could afford to keep up, beyond mere working supply and material trains, a medium equipment for common surface; and government would not be called upon as a donating power to bestow immense land grants on speculating individuals, to guard them against loss by running trains and depreciation of way over a non-paying route. Government should make all payments by issuing scrip in applicable sums—certificates to bear interest, and be payable within a limited number of years. Public lands sold to actual settlers along the line would, in the mean time, take up all scrip issued by government; sections of this narrow strip of valuable territory should be reserved for the growth of timber for the use of the road. The company building this road and encountering the risk of testing this first step of an experiment should be admitted to the single legitimate speculation of having donation and pre-emption fee of a limited quantity of land at station-grounds, but not to interfere with actual settlers. All speculations should be brought to the best engineering line for the road. The road should not be carried from its proper engineering position to further any speculation whatever. In the present instance, the engineering line is that which will best favor the most rapid extension of the iron rail to the mountains. The summit ridge between the mouth of the Kansas and the Platte is an obstacle to be encountered by a junction line, but not by the preliminary road. The favorable features presented in the above plan would be in the competition of the ablest actual railroad-builders in the nation to construct this road under the scientific direction of individuals educated and trained at the expense of government for the service of military defence. In the event of of war, this country will rely on her system of railroads for defence. By the revolutions of human progress the Pacific railroad is especially an arm of national defence. The military engineers of the country should have practice in this new branch of service; and as government is to furnish a portion of the means for extending this road, the scientific department to which is intrusted the erection of military works should not be debarred from participation in its construction. The practical energy of the civil engineers of the nation will at once turn toward the consideration of this project, and appear among contracting parties; and the basis of the plan of construction offered, however modified, will serve to blend these important branches of an eminent profession in the solution of a national undertaking.

BRANCH LINE FROM PUGET SOUND TO THE SOUTH PASS.

It will be readily understood that that portion of the route between Puget Sound and the plains of the Great Basin is the northern fork or branch of any central railroad to California. In describing the lines of this first portion of the route, I will term the belt of country extending from Puget Sound to Fort Boisé the first division; and that extending from Fort Boisé, through Snake River valley, to the plains of the Great Basin, the second division. From Seattle, on Puget Sound, to a point near the Dalles of Columbia river, all lines are common to both the northern (that of the 47th and 49th parallels) and the southern routes to Puget Sound. From that point to the approaches of the Blue Mountain range on the Columbia river line to the pass of the Walla-Walla river undulating grades of thirty-five (35) feet to the mile may be adopted to save work. The actual approach must be made at fifty (50) feet. In the continuation of the river line north of the Blue Mountains, the approaches can be adjusted at forty (40) feet per mile, and some difference of grade be adopted to save work. By the line from the vicinity of the Dalles, skirting the high country south (to avoid river bridges and severe cuttings of low summits near the Columbia) by detour and by "side hill approach," the first rise from the river valley will probably require grades of not less than fifty (50) feet per mile. All work in the vicinity of the valley of the Columbia is of costly character; but on reaching the surface of the plateau, at the base of the Blue Mountains, grades of thirty-five feet may be adopted. All these details of location will be studied in future survey, and the line chosen which shall seem best applicable to the summit of the Pass and its approaches. From the summit of the first Blue Mountain range the whole country toward the south is distinctly visible. The connecting spur between the Blue Mountains and the great Cascade range, near the source of the Des Chutes or Fall river, appears perforated by the headwaters of that river, and presents a low depression in their vicinity. The line of detour to which I have last referred, rising by the valley of the small stream near the Dalles and skirting the mountain base, would develop some of the richest country in Upper Oregon, and, through the pass of the headquarters of the Des Chutes, could make connexion with a route to California, by a descent to the plains of the Great Basin in a due southerly direction. The last-named route is not within the province of the present report. A line of such direct southern tendency should preferably pass west of the Cascades, and through Willamette valley and the gold regions of the coast. A descent east from the pass of the Walla-Walla can be made by skirting the valley of the Grande Ronde river toward the south, and thence crossing the summit between the Grande Ronde and

Powder rivers, by a system of curvature approach—the change of direction from a tangent of at least one thousand (1,000) feet, and the curvature of mile radii. The descent toward the waters of Powder river can be made by skirting the broken country south, (or nearer the headwaters of that river,) which is the apparent location for a Grand Trunk road, assuming the most direct line between termini. After crossing the summit between Grande Ronde and Powder rivers, the route can either skirt the base of the same hilly country toward the south, and which extends in an easterly direction to the valley of the Burnt river, or pass down the valley of Powder river to the Snake. Either location is practicable—the former the most direct, and the latter the least severe. The character of grade and curvature is favorable upon both, although continued rock-cuttings will occur near Burnt river upon the former, or southern line. The former or southern route can still skirt the mountain base, and crossing Malheur river, six miles from its confluence with the Snake, preserve an easterly direction toward Fort Boisé and the broad valley of the Snake. The northern can keep the valley of the Snake, and by side-cutting gain a road-bed through this valley, which, in the immediate vicinity, does not offer so favorable facilities for railway construction as exist a few miles further east. Either of these routes, hereafter assumed as a grand location line, will need care in adjustment, the engineering problem resolving itself into the "keeping up" of grade, or making facile descent from the pass at the head of the Walla-Walla, by skirting the Grande Ronde valley, and thence by skirting the broken and mountainous country south, avoiding too sudden and abrupt descents and ascents of the various water drains of this mountainous country flowing toward the great valley of the Snake, and which occur in the crossings of the Powder, Burnt, and Malheur rivers. Fifty miles of country, extending west from Burnt river, is severe, but of a nature which, reducing the character of the line, by adjusting either steep gradients or sharp curvatures, cannot obviate. Fifty per cent. of the work is rock-cutting at short haul, spurs of ledges, which cannot be avoided, but with no bad summit section. The work is so placed that large forces of laborers could be applied to it. At prices of excavation in New York and the eastern States, this 50 miles of line could be readily reduced to gradients of 40 feet per mile, and a road-bed of 35 feet, (which admits of a first class line, with double track of wide gauge, properly ballasted and drained,) at $100,000 per mile. This is the severe ledge section of the line east of Columbia valley, and extending to the Great Basin. The summit section of the Walla-Walla will undoubtedly prove deep ledge-cutting, and may require tunnelling, but its approaches are of 80 per cent. earth. From the valley of Burnt river to Fort Boisé no great difficulties of location or construction will occur. The route, by detour through Snake River valley, would possess features of a decidedly more favorable character, as traversing a gravel surface. In reaching the country in the vicinity of the Powder river, the route north of the Blue Mountains would occupy common position with the most northerly of the lines yet reported upon or continue down the valley of the Snake. Side-cutting would occur in the latter instance for a distance of twenty (20) miles, or would be avoided by forming a road-bed of the débris of the neighboring basaltic ledges, which are near the mouth of the Burnt river, and jut down upon the line.

For the purpose of keeping a road elevated in approaching the higher plateau west of Fort Boisé, the line should encounter the ledge-cutting. This would render the road more expensive at the particular section, but would reduce cost in advance. No deep rock-cutting should occur upon a preliminary railroad. The line could be temporarily adjusted to make passage of this unfavorable point for first transportation to the interior, and, when the obstacle is reduced, the main route supersede the preliminary one. The description of the second division of the route from Puget Sound to the plains of the Great Basin may be briefly summed up as the extension of a line over a broad gravel surface, at merely nominal cost of grading, all questions of location being readily solved. The connexion between the southern plateau of Snake river and the valley of Bear river was obtained by passing up the valley of the western fork of the Bannack river, and over prairie surface of clear gravel formation, to the waters of a small stream seeking an outlet in the Roseaux, or Southern Malade, a tributary of Bear river. Three very practicable passes were examined in this vicinity, and of these, that to which I have first alluded is the superior. The character of the country, as ascertained by an examination of both the northern and southern bases of the northern rim of the Great Basin admits the practicable passage of railway lines between Snake river and the Great Basin at numerous low passes dividing this range north and south. The topographical sketches of country in this vicinity, taken by the late survey of the Salt Lake Basin, are very characteristic, and define its features with great fidelity. Passage can be readily made north and south, but it is not so facile at angles to that direction. The technical description of the first division was entered into as affording information to future survey, and is of slight interest to unprofessional parties.

BLUE MOUNTAIN RANGE, AS CONNECTED WITH ABOVE DESCRIPTION OF LINES.

The exploration of the Blue Mountain range was first directed toward the headwaters of John Day's river; and the approaches proving of more serious character than first anticipated, I was then led to confine myself to approaches of more practicable nature near the headwaters of the central fork of the Umatilla. To the latter pass, which is termed that of the Young Chief's Trail, I gave a very thorough and careful examination, from the result of which I am compelled to pronounce it impracticable for a Pacific railroad. By barometric approximation, the summit of the Blue Mountains (the Young Chiefs Trail) is 4,650 feet above the sea. Railway summit at head of lowest swamp, 4,393 feet above the sea, by the character of the "approaches," involving twelve (12) miles tunnelling and continual water drift. When such obstacles (encountered at a distance from civilized communities) can be avoided by reasonable detour, no claim of direction should style them practicable in comparison. This result affords no grounds for a judgment against the pass of the Walla-Walla, delineated on the sketch, which has been known for years as a low passage of the Blue Mountain range. It is situated at the head of the numerous branches of the Walla-Walla river, and in the vicinity of the remarkable valley of the Grande Ronde. It should be made the line of passage of these mountains by a main road, but I have proposed the extreme northern passage of the great valley of the Snake for a preliminary railway.

IN REFERENCE TO THE SELECTION OF A TERMINUS AT PUGET SOUND, FIRST SECTION OF LINE.

In recapitulation, I shall state the merits of these divisions regarding construction, dividing the first division into three distinct sections. I will quote the language of General George B. McClellan, then chief in charge of the western division of the northern exploration, a military engineer of practice and ability, whose opinion on the selection of a great harbor on an isolated coast, needing thorough protection by the erection of suitable fortifications, is entitled to consideration. The opinion of Governor Stevens concurred with that of General McClellan, and the experience of both gentlemen in their peculiar branch of service places the selection beyond a question. General McClellan states: "I have mentioned Seattle as the proper terminus for the road, whether it crosses the mountains by the main Yakima, or by the Columbia River Pass. This place is situated on Elliot bay, and is by far superior to any harbor on the eastern shore of Puget Sound. Seattle is the nearest to the Straits of Fuca. It is easily entered with any of the prevailing winds; is secure from heavy seas, and has a most excellent holding ground of blue clay, and a good depth of water—thirty fathoms. The banks are suitable for a town; the deep water comes so near the shore that but very short wharves will be required. Semi-bituminous coal can be found within fourteen (14) miles by water. The harbor can be defended by permanent fortifications." From Seattle to Vancouver, a distance of one hundred and sixty-five (165) miles, (round numbers,) twenty-five (25) per cent. of all grading will consist of high prairie plains of light soil embankments built by side work in easy gravel shovelling. Fifty (50) per cent. of work extended plateau, of heavily-timbered country; low, wet surface; deep black soil; embankments built by long haul with gravel trains. Twenty-five (25) per cent. of work, undulating surface of equalized cut and fill; fifty (50) per cent. of the latter is ledge excavation at short haul; no deep cutting; no gradients over forty (40) feet per mile; curvatures of mile radii, readily located; minimum amount of masonry; stone suitable for rubble-work at Puget Sound. Brick clay is reported in abundance, but not seen by engineer. More than average facilities for railway construction at reasonable cost.

FROM VANCOUVER TO THE DALLES OF THE COLUMBIA, A DISTANCE OF NINETY (90) MILES.

Not less than fifty (50) miles of heavy embankments exposed to the action of water in the great freshets of the Columbia river; to be formed by borrowing in the broken débris of basaltic ledges, a material abundant throughout the river valley; the weightier blocks to be placed at their natural slope upon the face of the embankment; forty (40) miles of equalized side-cuttings and embankments; the excavations averaging seventy (70) per cent. of ledge. No gradient exceeding 15 feet per mile, unless at the discretion of the engineer. Curves of 2,000 feet radius, and a reverse within 200 feet of tangent point from intermediate straight line; or a tunnel of 700 feet at the mountainous point, termed Cape Horn, but avoided by preliminary road. Maximum amount of rough masonry; first class bridge-masonry at a crossing of the Columbia, 1,200 feet in length; stone suitable for rubble-work, if combined with brick work, may be procured in vicinity of line. Brick clay occurs in abundance in vicinity. A fine variety of mountain pine, suitable for all timber structure and tressel-work in vicinity of line. First step in grading, the construction of the road around the falls or cascades of the Columbia, to connect water transportation. The whole section of 90 miles to be assailed during first labors of grading, that supplies and material may be transported to the divisions of the interior. A severe and costly section, requiring the experience of first class engineering faculty for proper reduction at reasonable outlay.

FROM THE DALLES OF THE COLUMBIA TO SNAKE RIVER, NEAR FORT BOISÉ—GENERAL APPROXIMATION OF FACILITIES FOR RAILWAY CONSTRUCTION OVER WHOLE DIVISION.

Fifty (50) per cent. fair gravel work; equalized excavation and embankment, at reasonable average haul; thirty per cent. of ledge in side-cutting; summit sections thirty per cent., hard material; loose rock and hardpan; twenty per cent. of all gradients fifty feet per mile; room for reasonable adjustment of curvatures of 2,000 feet to one mile radius; abundance of first-class timber for all structures to vicinity of Powder river; brick clay in quantity near Powder river; abundance of boulders, affording suitable material for all minor masonry in the vicinity of Grande Ronde and Powder rivers; granite in quantity near Burnt river; brick clay near Malheur river; at mouth of Malheur river, pine granite suitable for masonry; near Fort Boisé, excellent material for masonry in various localities; some timber, with facilities for boating or rafting upon the great tributaries of the Snake river. The western portion of this section affords fair opportunity for railway construction at reasonable cost. The problems of construction readily solved, experience in location being mainly required to give the line its best position over such broken, undulating country. Should the line pass to Fort Boisé, by detour towards the north, through the valley of Snake river, gradients would be materially reduced, and this broken country, in a measure, avoided. From Fort Boisé to the valley of Bear river, the route is of nearly uniform character. The line would traverse a high gravel or sand plateau, requiring mere nominal grading to prepare it for the rail. A few spurs of the hilly country towards the south extend towards Snake river, and can be encountered by the line and reduced at low cost, or readily avoided. The changes in level are very gradual and occur in broad terraces of many miles in extent, gradually rising toward the eastern mountains. Brick clay occurs in quantity upon Katherine creek, so called. The scarcity of wood in the vicinity would prevent its use; but the extension of a preliminary road over the broad surface of these level plateaus would transport all necessary material to any section required at low cost. Sufficient timber exists in the vicinity of the line (a species of mountain fir upon the hilly country south, and stunted cedars upon all low summits) to allow the ready extension of a line of rail, by the laying of a cross-tie and rail upon the level surface. This section preserves its character in approaching the summit of the dividing range between the waters of the Snake river and the Great Basin. The approach is very easy, and the summit itself is an elevated gravel plain. By gradually approaching along the mountain side—the position of which allows the adjustment of the line by regular curvature—this summit can, undoubtedly, be accomplished by a cutting of thirty (30) feet in gravel, and gradients not exceeding fifty (50) feet per mile. A preliminary line could be extended over it without more excavation than necessary for the adjustment of the superstructure. The descent to the plains of the Great Basin is more difficult than the rise from the valley of Snake river. It may be readily accomplished, however, at low cost. The whole country is open. From surrounding summits the inclination towards the pass and entire line of approach is distinctly visible. The vicinity is remarkably favorable for railway location and construction. The chief difficulty to be apprehended is from the scarcity of timber, both in the immediate vicinity of the Salt Lake and over the whole section extending to Fort Boisé. This difficulty must be obviated by the use of a preliminary road; for the construction of which, suitable stone for masonry is found on the northern rim of the Great Basin. Timber occurs in average quantity in the mountains north of Snake river; for all the purposes of a preliminary line, it can be obtained in the vicinity of the route. From the need of the construction of a preliminary road to complete any railroad to the Pacific within a reasonable time, I shall therefore state that this second division of the route or section, extending from Fort Boisé to Bear River valley, or the plains of the Great Basin, presents extraordinary facilities for the construction of a railroad at minimum cost; and that in the comparison of the engineering features of the lines from Puget Sound, in an easterly direction, to Bear river, upon this southern, with an equal distance upon the northern route, the advantage is immeasurably in favor of the southern line. It may be reasonably affirmed that the extension of a railroad line from the Great Salt Lake City to Puget Sound, or from the route of a railroad from California to Puget Sound, is eminently practicable. The character of the Columbia River valley is severe in places; but it should be borne in mind that it is a pass or passage of the Cascade mountains, and is, therefore, merely to be weighed in comparison with other passes, as incurred by all other lines. It is common to both the northern and southern routes to Puget Sound. It is the most severe section upon the southern, but by no means the worse section upon the extreme northern route. I may observe, in this connexion, that the Grand Pass of the Yakima river, or the Snoqualmie Pass, to which so much attention has been given, is in far better direction in extending the southern than as a continuation of the northern route to Puget Sound. By a glance at the map, it will be observed as occupying a direct line from the Walla-Walla to that terminus. Should future instrumental survey demonstrate the section to be more practicable than is now anticipated, it will be a source of pride and gratification with me to withdraw any expression of opinion I have offered on the subject, and to claim the location thus developed as giving still greater character to the southern route to Puget Sound. It must necessarily appear, however, that during the excavation of the deep rock-cutting and long tunnel of this summit communication should be extended to the interior; and I should most emphatically advise the development of the Columbia valley, by cheap railway facilities, to afford such communication. The cheap or rough railway to be extended to the interior by detour from direction north of the Blue Mountains and through the Snake River valley to the extensive plateaus east of those mountains, solving the problem of construction at low cost, and existing for the period of years required to construct the more direct route of the Walla-Walla and Powder rivers, as a full solution of the Pacific railway problem.

CONNEXION OF BRANCH ROUTES, AS ABOVE DESCRIBED, WITH THE VARIOUS CENTRAL ROUTES TO CALIFORNIA.

Connexion can alone occur with the straight route of the 38th and 39th parallels from St. Louis to California, (that advocated by Colonel Benton,) by extending the branch line from Puget Sound along the eastern shore of the Great Salt Lake, and by the line of the Mormon settlements to the vicinity of Little Utah valley—an entire distance, in round numbers, of 1,200 miles from Puget Sound. Should the Pacific line reach California through the Bridger's Pass, the connexion of the branch road could take place on the plains of the Great Basin near Salt Lake City, by a route of 1,050 miles from Puget Sound. But should the line to California adopt the route of the South Pass, a line might be adopted which would afford opportunity for the connexion of the branch road to Puget Sound by a route of 875 miles. In the latter instance, the Pacific project would be restricted to reasonable limits, and to the least cost in first outlay which will afford results desired. My estimate of the cost of a branch line will be confined to the intermediate length of line of 1,050 miles.

ESTIMATES OF COST.

No estimate of the cost of a Pacific railroad can be deemed reliable, from the remarkable contingencies which must inevitably occur during the consummation of the project, and serve to defeat what may at present appear quite warrantable conclusions on the nature of the question and the cost of the road. I resolve the whole question of the construction of a railroad to the Pacific, in present estimates, to the mere extension of a railroad to the Pacific, of unelaborated character and of medium equipment; not in broken, or temporary working sections, but actually making connexion between eastern lines of similar gauge, and eastern water transportation, and a Pacific terminus. The connexion with terminus and the passage of trains, without breaking bulk, along the whole line of the road, giving greater character to the conviction I have so often directly expressed, that the construction of a preliminary line will lead to the most effective solution of the question in its manifold relations. When contiguous to settlements, and under due prospect of remuneration from way-business, this line need not necessarily be confined to a preliminary character; over no section encountered in the passage of the continent, necessarily confined to any peculiar character or class, save as under attendant liabilities; and while always subject to the principle of expansion, or of elaboration, as circumstances shall direct, still never surrendering the obvious necessity of the earliest practicable connexion of termini. Should the passage of the great obstacles to railway transit—by the channels perforated through them by the act of nature, in the flowage of the waters of the interior to the ocean—be prevented for a few weeks by the freshets of the mountains, it is still assumed, in this estimate, that the use of the rail eleven (11) months of the year, during the long period while these obstacles are being overcome by the means of transportion thus afforded to supplies, laborers, and all needed appliances, will still prove a remarkable desideratum in the early consummation of the project. But a road of rough class, admitting the passage of weighty trains, and reaching the Puget Sound terminus by practicable detour, can be completed from the waters of Missouri river to Seattle, on Puget Sound, for fifty millions ($50,000,000) of dollars in cash capital, actually expended on the construction and equipment of the road; (with all contingencies, depreciation, workage, management, inadequate appropriations in broken sums, credits, &c., say $75,000,000.)

The following estimate for the branch road of one thousand and fifty (1,050) miles embraces a larger sum per mile, from the better class of line proposed over certain portions of the route, as probably required by adequate way-business, and as more ecomically accomplished if attempted at the outset:

From Seattle to Vancouver, on the Lower Columbia, a distance of one hundred and sixty-five (165) miles, facilities existing for cheap construction, a preliminary line of better class than would be attempted in the far interior, with a rail of sixty (60) pounds per yard, or structure of corresponding strength, and reasonable reduction of surface, erection of rough masonry, &c., at the present prices of the Pacific coast	$4,125,000
From Vancouver to the Dalles, a distance of ninety (90) miles, and including a passage of the Great Cascade Mountain chain, a line of rail of sixty (60) pounds per yard, secured by mechanical appliances, and admitting the passage of a locomotive engine and train without breaking bulk, the temporary road-bed of ledge débris covered with water, and unserviceable during the freshets of the Columbia..............................	3,150,000
From the Dalles to the plateau surface at northern base of Blue Mountains, including bridge of Columbia, and approach to upper plateau surface from lower level of Columbia valley, one hundred and fifty (150) miles	4,500,000
Passage of Snake River valley plateau and cañons, a distance, in round numbers, of two hundred (200) miles, some portions of line unserviceable during the spring freshets of Snake river, involving some preparation of rough surface to use best route of descent to Boisé, but with long stretches of level gravel plains	6,000,000
From Fort Boisé to the Great Basin, including passage of the Pannack, by practicable detour, say five hundred (500) miles, over gravel plateau..................................	9,000,000
For general approximation, say eleven hundred (1,100) miles of road from Seattle, on Puget Sound, to the plains of the Great Basin	26,775,000

As connected with a railroad line to California, by the South Pass and valleys of the Snake and Pannack rivers, the branch road would be subject to a reduction, in cost, of about four millions of dollars. In the above estimates an addition of fifty (50) miles, at an average cost, has been made for contingencies and probable deflections in locating a preliminary road. I would double this estimate, which I would then regard as a close approximation to the actual figures of construction.

CONTINUATION OF RECONNAISSANCE TO MISSOURI RIVER.

"The route just described is, as heretofore stated, the northern branch of a forked route, the main stem of which extends from the plains of the Great Basin to Missouri river. The southern fork of this route and the main trunk stem is termed, in the reports of the Pacific explorations, the route of the 42d parallel. Two of the lines of the route of the 42d parallel respectively extend—the one through the South, the other through the Bridger's Pass of the Rocky Mountains. I consider the choice between, or selection from, these two lines the most important and interesting of the many engineering details connected with the adoption of the line of a central railroad to California. This is especially the case if the selection is to be guided by a determination to reduce the whole question of a railroad to the Pacific to the construction of such a sort of military railroad as shall reach the Pacific coast within seven years. The statements of the introduction to this synopsis will now have their weight, and simplify the final engineering presumption of that paper—that Congress should hesitate to do more, at the present time, than aid the construction of those first sections of the Pacific railroad lines contiguous to the States; aiding the first sections of routes of undulating surface with reference to the needs of civilization and way transportation, if deemed constitutional, by land grants; but aiding the two of plateau surface, extending over broad plains, with a view of the earliest practicable connexion of termini.

"The following reasons are offered for arriving at such definite conclusions in reference to the route of the 42d parallel: The first section of this route is the line of approach to both the South and Bridger's Passes of the Rocky Mountains. The examinations of these passes have been confined to reconnaissance, and have not yet been verified by survey. The South Pass is nothing but an extended plain, slightly broken towards the south into an undulating country. It is the first breakdown of the great Wind River mountains at the north, among which is a summit of over 12,000 feet above the sea. In this plain and among these ponds and swamps heads the waters of the tributaries of the grand Colorado, the Snake, and the Platte. The engineering rule, in seeking location over broad belts of surface between termini which extend at angles to the direction of great water-courses, is to skirt the country in which they head, or to pass over the lower delta where they have deposited in broad terraces the earth from the deep channels excavated by their flowage, rather than to adopt the intermediate region, broken by their transit. Reconnaissances for the location of Pacific railroads only differ from those of minor lines as the broad divisions of a continent differ from the limited sections of the country and the State, and as the choice of routes is affected by the claims and contingencies of construction brought forward by the extreme length of line to be traversed, in the wear of the road during deferred connexion of termini. The inclinations of gradients are affected by the character and length of the approach, as much (in general terms only) as by the elevation of the summit to be overcome. A line which reaches, by the long inclined surface of the Platte valley and the Sweetwater, the level plains of the South Pass, and thence, without surrendering height accomplished, passes over the gradual slope toward the west of the valley of the Snake, and thence, by the low pass of the Pannack, reaches the plains of the Great Basin, necessarily avoids the steep grades induced by a descent into the great valley of the Colorado, (see route 39th parallel, and in less degree, 42d parallel,) and the subsequent rise over and descent from the Wahsatch mountains to the plains of the Great Basin. The intermediate country, broken by the passage of water, is avoided by detour. Therefore, were this surface of the swamps and sand plains of the great South Pass not at so great an elevation above the sea as to place it near the regions of perpetual snows, the argument would be unanswerable regarding its selection in reference to the extension of a preliminary road. This is an evident conclusion, because the engineering requisition to be answered is, the finding of a continued line of flat or slightly inclined surface, over which a railroad may be extended to the Pacific within seven years. But if the preliminary road traversed the plateau of the South Pass, and the long flat line of country beyond it, fully 7,400 feet above the sea, it would be exposed to the inevitable dangers and embarrassments of this elevated region, regarding snow and frost. To expedite preliminary arrangements it has been proposed to use the natural surface (where of gravel or sand substrata) without grading. Over the South Pass this could only take place during half the year. But in a more deferred mode of extension the facile line of approach to the South Pass will permit, by the adoption of steeper gradients, of the erection of an embankment road bed, which will in some measure guard against the obstacle of snow. Even an open structure, through which snow would drift and over which trains could pass, might thus be adopted, or (with the surface road) a covered way under which trains could make transit. But in reference to snow the elevation of the summits of the broken and undulating surface in the vicinity of the Bridger's Pass are but slightly below that of the flat plains of the South Pass. The excavation of cutting, and the erection of culverts and bridges for the passage of water, would there unquestionably postpone communication, and in a measure prevent the earliest use of the carrying road. Again, every railroad employé knows the difference between a cutting and an open road, regarding embarrassments from snow. The mountaineers of this section state that they can travel over the plains of the South Pass in winters, when the gorges of the more southern line are filled with snow and impracticable of passage. Early communication is the desideratum, and this drives us to the most rapid extension of a preliminary railroad. Therefore, in view of the extension of a similar line as a winter road over the sand plains of the extreme southern route to California, I should give the preference to the route by the detour of the South Pass. Notwithstanding some increase of distance and of the cost of rails, it would probably be less expensive than the other, and would sooner reach the plains of Snake river and the Great Basin, and carry supplies for a working section across those plains.

"But, returning to the engineering presumption first submitted, we might more reasonably infer that, from the difficulty of arriving at a conclusion at the present time, this question of choice between two lines of a route should be left open. It should be determined by future examinations during the construction of that first section of the line of the emigrant road, which is the grand approach to both the South and Bridger's Passes of the mountains; although, to prevent postponement and delay, the construction of the first section should most certainly not be compelled to await the solution of this engineering question. Between the South Pass and the eastern slope of the Black Hills, (so called,) the preliminary line would, in some instances, be confined to the narrow, but by no means costly, passage of the Sweetwater river, while the main route would necessarily adopt a more direct location. The whole section is of favorable character. In the adjacent mountains excellent timber can be readily procured, and first class material for masonry exists contiguous to either line. The earth excavation is in clear gravel of that superior quality which best preserves superstructure from the effects of severe and sudden changes of temperature and frosts, and which gives the most perfect drainage when formed into a road bed. Reaching the valley of the Platte, all difficulties of location cease, and a broad bottom land, falling at scarcely perceptible inclination to the very banks of the Missouri, and overlaying a substratum of clear gravel or sand, offers every facility for a cheap construction. This broad surface of bottom land breaks toward the north into ranges of low sand hills. Clear streams flow from these low summits at irregular intervals of distance; and, from the facility with which their waters can be delivered at sufficient elevation above the rail for the use of locomotives, will prove of great value to the line—the turbid waters of the Platte not being so well suited to that important purpose. In the edge of these sand hills, and beyond all danger of freshets, a preliminary road can be extended towards the mountains. Stone of medium quality occurs upon the Platte and at the junction of the line with the Missouri. I am compelled to state, however, that, with all its attendant advantages, the route through the valley of the Platte labors under what may be termed a peculiar objection to any railway line to the Pacific. Two hundred (200) miles of the distance between the first broken country and the Missouri is entirely destitute of timber, and the remaining portion but sparsely wooded with the cotton. The waters of the river are broken by sand bars, which would probably prevent rafting from the mountains. This peculiar feature of the line should be especially regarded from the fact that the State of Iowa, which is the eastern terminus of the route, is also scantily timbered, and that the whole upper valley of the Missouri can give but slight aid in the connexion. The northern route labors under difficulties of a similar character in its passage to the mountains, but, by changing the location after the liability was developed by reconnaissance, it may now be readily overcome by the construction of the road over the detour line of Little Falls; a line from a point on the Mississippi opposite the mouth of St. Croix river, and extending to the Missouri, near the mouth of the Platte, would deliver the superior timber of northern Minnesota and Wisconsin at the debouche of the present line, and provide the great Territories of Nebraska and Kansas with the lumber of which they are so deficient, and which the whole upper valley of the Missouri does not afford. The want of timber upon the Platte does not extend to the deficiency of fuel for locomotives. Coal of excellent quality abounds upon the northern Platte, and evidently underlies the whole eastern portion of the route. Less bulky than wood, it is easily transported. Sufficient timber is now growing in the Missouri valley and near the lower waters of the Platte to admit of the immediate extension of a preliminary road; and, in the event of its construction, operations should be commenced by which the fertile country in the vicinity should be made susceptible of improvement in this respect. The mere suspension of the prairie fires will tend to the object; but well instituted experiments have demonstrated that several varieties of timber are readily grown from the seed upon the western prairies, and that a period of ten years is sufficient to make their results available. The coal beds of western Iowa, and of the whole great section near the base of the mountains, with the existing probability of abundant supplies beneath the intervening surface, are of great importance in sustaining the character of the present route by removing all absolute necessity of planting timber for the mere purpose of fuel. The reduction of coal to coke for the use of locomotives may be readily attempted at those points where the raw material is abundant in deposit. The yield of the present variety would average about two-thirds of the weight of coal. The erection of coke ovens in the vicinity of the coal district will reduce cost of transportation, and the reduction of coal to coke, which is peculiarly adapted to making steam, will prove the better economy. The use of coke is not common in America, from the abundance of wood at the numerous way-stations of all inland lines. Experiments have been conducted upon several of the best eastern roads on the use of coal in locomotive furnaces. Engines have been constructed for the purpose of carrying out the results thus obtained. The Boston and Lowell Railroad Company have made a trial with one of their locomotives of the relative value of wood and coal for fuel. The result of the trial is reported as follows: The whole distance run was 2,366 miles, of which 1,868 miles were with freight, using one cord of wood in 26 miles, or 68 cords, at $7, amounting to $476; and

598 miles, with passengers, using one cord of wood in 30 miles, amounting to $199 51. Total expense of working by the use of wood, $615 51. The expense of running the same distance with coal, at the rate of $6 50 per ton, (the cost in Boston,) amounting to $265 46; being a saving in favor of coal of $350 03, or above one half. This is quite an item. Experiments made on the Illinois Central Railroad in 1856 have solved this question; coal is proved more economical than wood, and will now come into general use as fuel for locomotives. A favorable bridge crossing of the Missouri occurs at a point a few miles north of the mouth of the Platte river, at the old ferry of the Indian trading post, and adjacent to the present Omaha Indian mission. Other crossings of the Missouri are practicable, both north and south of that point. A Grand Trunk line, assuming the most direct route from the first pass of the Sweetwater to the present bridge crossing of the Mississippi, can procure a position further north; and that of a route avoiding the great eastern bend of the Platte can readily be adjusted further south. The whole subject will be fully solved by the numerous surveys of private lines seeking connexion with the great road to the Pacific; and, in this respect, the eastern terminus of the route, which the present report embraces, might properly be located at the head of Grand island, near Fort Kearney, where all roads of local character can make connexion with it."

The foregoing chapter sets forth, therefore, in brief detail, all the physical difficulties to be met with on the central branch route to the Columbia, and it now only awaits the steady action of the capitalists and engineer to put the question into a practical shape. As a means of retaining our Pacific possessions by indissoluble ties the building of this road is imperative. National defence and national preservation alike demand it. When, by the aid of the genius of American engineers, even the autocrat of Russia unites his extended possessions by the construction of military roads, it is a suggestion to the policy of a republican people whether they do not hesitate too long in adopting that means of rapid communication, which will continue to confine the military operations of the country to their present simple and effective character. Forts and standing armies were once deemed national means of protection, but new methods of defence may be made the causes of aggrandisement.

When a city is the growth of a year, and our own San Francisco the wonder and admiration of the world; when the passage of the ocean but a fortnight; when the newsboy cries the morning message of an English telegraph, and the aged man is whistled through space by the flight of steam; then will a military road be no longer deemed the passage of a hill-side, or the crossing of a river no longer a simple problem for the engineer to solve; but it rises to one greater, handled, and used by the statesman and by him advocated as a means of concentrating and rapidly moving suddenly organized forces of the volunteer soldiery of the land to the utmost verge of our borders, thus giving ample protection to the furthest settlements of the republic. The Italian campaign and our own present difficulties have developed the importance of the railroad in all military operations, and have afforded, if any new proof was wanting, the fullest and most complete demonstration that in this era, at least, the railroad is, par excellence, the best military road that a nation can use. How important, therefore, to the United States, does the Pacific railroad problem become, and the necessity for moving in the matter at an early day. The Pacific coast, though piqued under the infliction of neglect, is yet patient and hopeful that the date of initiating this grand work, so important to her fullest development, is not far distant. How important to California and the people of Oregon and Washington becomes the choice of location for such a road, and of what paramount consideration all that shall tend toward the expediency of constructing it, its prospects of remunerating private interests, and its means of augmenting public welfare.

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., January 5, 1860.

SIR: In accordance with your letter of instructions, I left the Dalles on May 16, 1859, for the purpose of examining into the practicability of a railroad line along the Columbia and Snake rivers, from the Dalles to the mouth of the Palouse river. Before entering into details it would be perhaps better to say something of the general character of the route, and more especially of the question of grades, which in most lines of railway is the subject of chiefest difficulty.

A glance at the accompanying profile, together with the following considerations, will show that if under any circumstances a railroad is practicable, along the Columbia and Snake rivers, the problem of grades is of easy solution; a large portion of the line is on the broad flats between the bluffs and the river, where there is no engineering difficulty to be surmounted; a considerable part, also, and such sections will be examined in greatest detail, lies along the face of steep rock bluffs, with the river laving their base, and where, by a variation of a few hundred feet to the right or left, the line can be elevated or depressed the greater part of this distance; here it is sufficiently evident the question is not one of grades. Still another portion is on rolling plateau, which sometimes continues for miles, with very gentle ascents and descents, and then breaks off suddenly with sheer precipices of from fifty to one hundred feet in height, compelling the engineer to take steep side hills beyond; and these are the only sections where any difficulty from grades can be apprehended. Further investigation will show that even here the difficulty is not great.

To afford a cheap line of railway from the Dalles to the Umatilla river, beyond which point I will not go into detailed report, from being incapacitated for field work by sickness during the remainder of the exploration, the amount of curvature must of necessity be considerable, but much less than those unacquainted with the peculiar features of the country might suppose.

In almost all cases where large ravines occur, the bluffs recede from the river and broad flats intervene, and where the precipitous rock cliffs come down to the water, a straight line can often pass along their face for half a mile without leaving the surface more than a few feet. There are many points along the line where a large amount of rock cutting and embankments would be necessary; and, probably, in several places short tunnels would be required; but the average cost of the line would not be great, if curves of 1,000 feet radius, as a minimum, should be adopted where the nature of the ground required them.

Regarding the means and manner of operation during the exploration, the instruments used were a compass, spirit level, and odometer; the latter attached to a small wheel fitted with axle and shafts, and rolled along the line as surveyed.

Mr. Sohon was compass-man and topographer from the Dalles to Mud Spring; thence Mr. Johnson took his place to a point some ten miles west of John Day's river; and the remainder of the line was surveyed by Mr. De Lacy.

The level was used by myself until we had nearly reached the Umatilla, where sickness forced me to leave the party; Mr. Johnson taking my place as leveller, and the charge of the party devolving on Mr. De Lacy, who completed the special exploration. The map of the line was made by Mr. Sohon so far as he surveyed it, and the rest by Mr. De Lacy; the profile by myself. In the following report, as well as in that of Mr. De Lacy, the stations as referred to are taken from the level book and are identical on map and profile.

The high water mark as given on the profile was taken from actual observation of the greatest height of the water in 1859, when, I am assured, it was higher than at any previous time in the knowledge of the white residents of the vicinity; and it may be safely predicated that a line of railway located a few feet above this mark, as given, would be safe from any incroachment of the water of the Columbia river.

It is necessary to state that, whilst the profile was made entirely from the level notes, the level line as run was not in many instances exactly over the ground which was chosen as the better line of location; but being limited in time as well as means during the survey, and there having been no previous examination of the ground, I was forced to content myself with merely noting in the field book the variation between the line as run and that afterwards selected. The field book will therefore frequently show the data used in the report where the profile does not.

The initial station of the survey was taken at a point on the Walla-Walla road two miles east of Fort Dalles; and a bench mark, made on the root of a small oak tree near this station, was taken as one hundred feet above the base line.

From station 1 to Five-Mile creek, distance two miles, the line rises forty five feet to the point selected as the best bridge crossing. About one mile of embankment, six feet high, and one-fourth mile rock cutting, five feet deep, necessary; small culvert, six feet span, at Three-Mile creek. Length of bridge across Five-Mile creek, 140 feet, good natural rock abutments at about the same level, and fifty feet above water.

From Five-Mile creek to station 27, distance 1½ mile, the fall is 5 feet. Between these points the ground is much rougher; about ¾ mile of rock cutting, 8 feet deep, and ½ mile embankment, 10 feet high, necessary. From station 27 to 32, distance 1 mile, line rises 10 feet; work here is mostly in sandy earth, about ½ mile earth cutting, 15 feet deep, and ½ mile embankment, 15 feet high, will be required.

From station 32 to station 40, distance 3 miles, rise 10 feet. Between these points the quantity of work necessary is estimated as about equal to ⅞ mile rock cutting, 10 feet deep, and ½ mile of embankment, 30 feet high.

From station 40 to 43 the section is much more difficult than any yet considered. These points are on the same level, and their distance apart 1⅜ miles. Between them will be necessary ½ mile embankment, 20 feet high, which extends for some 800 feet across a shallow corner of the river, then a tunnel of ¼ of a mile, about; and then to station 43 the line passes for some 600 feet over another and much deeper corner of river, where a bridge will probably be required. The exact depth of the river at this point could not be ascertained, but at high water it must be at least 20 feet, and the current for a part of this distance is quite rapid.

From station 43 to station 53, distance 2¼ miles, rise 77 feet, grade 34 feet per mile, there will be necessary 1 mile embankment, 10 feet high. Between station 44 and station 53 the cliff makes a sharp bend, requiring a curve of 2,000 feet radius, an angular deflection of 80°.

From station 53 to station 54, distance 0.44 miles, line level rock cut averaging 10 feet for the whole distance. This is on an elevated plateau, which breaks off suddenly at station 54, with a fall of some 70 feet. Between stations 54 and 55 is another difficult section. The line leaves station 54, passing along a very steep side hill for about ¼ mile; then curves for some 30° with radius of 1,000 feet, and passes on a straight line through a high rock bluff, with a tunnel of about 1,000 feet; then with a curve of larger radius and some 90° of angular deflection, it keeps the rising ground behind the Des Chutes village, and passes on a straight line across the Des Chutes river to station 55. For the first 1.4 mile the fall is 42 feet, grade 30 feet per mile; thence the line crosses the river on a level, and 15 feet above high water mark to station 55. Length of bridge over the Des Chutes river 480 feet. Good abutment and pier foundations. Whole length of embankments at both ends of bridge 900 feet, height 15 feet. The whole distance from station 54 to station 55 on this location is

1.85 mile, but, by a mistake in the odometer readings, which was not discovered until after the profile was finished, the distance, as it appears on the profile, is 0.67 mile too short. This will be noticed on the profile as well.

From station 55 to 61, distance about 1½ mile, rise 7 feet. Work about equal to earth cutting 6 feet deep all the way.

From station 61 to 62, distance rather more than 1 mile, fall 16 feet; the grade line leaves the surface more than a foot either way between these stations, material all sandy earth.

From station 62 to Mud Springs, distance 2 miles, rise 34 feet; 1 mile embankment, 10 feet high, and ¼ mile earth cutting, 6 feet deep, necessary. A culvert of 6 feet span required at Mud Springs creek.

From Mud Springs to station 79 the profile of the selected line of location is entirely different from the level line as run.

Between Mud Springs and station 74, distance 2¼ miles, fall 34 feet, the line for the first mile is along the slope of very precipitous rocky bluffs; work for this distance probably ½ a mile of rock cutting, 20 feet deep; for the remaining 1¼ mile the work is very light and nearly all in earth.

Between stations 74 and 79, distance 7 miles, rise 68 feet, the line here lies mostly along the level or gently rolling river flats, where both excavation and embankment would be slight, and the material most all earth; but for a distance of 2,000 feet back of station 78 the line is near the base and along the surface of nearly perpendicular rock bluffs rising from the river; here work would be required equivalent to rock cutting some 50 feet deep; but, even should a tunnel of 2,000 feet be required, it would be much preferable to the heavy grades of the line as run and indicated on the profile. About ¾ mile back of station 79 is a ravine, where a culvert of 12 feet span would be required; also two small ones of 4 feet span between stations 76 and 78.

Between stations 79 and 82, distance 1 mile, is John Day's river; the line falls 16 feet in the first ½ mile, crossing the river on a level, which continues to station 82. Length of bridge required 450 feet. Foundation for east abutment solid; both west abutment and river foundation would probably require filling. Embankment on west side for ¼ mile, averaging 20 feet in height; on east side very little needed. From station 82 to 90, distance 3¼ miles, the line continues level. No engineering difficulty between these points; 1,000 feet of rock, cut 20 feet deep, and ¼ mile embankment, 20 feet high, would be about equivalent to the work required. Culvert of 4 feet span between stations 86 and 88.

From station 90 to 92, distance 2 miles, fall 20 feet, 1,000 feet of rock cutting, 6 feet deep, required; no embankment, one culvert of 5 feet span.

Between stations 92 and 95, distance 2 miles, rise 60 feet, there are two very precipitous rock bluffs of 100 and 80 feet in height, respectively. The line passes about 15 feet above the base, and along the face of the first for some 1,500 feet; here tressle work would probably be most economical. The second is about ⅔ mile back of station 95, and by cutting through this for 300 feet with an average depth of 15 feet, the line would pass with very little more work up to station 95.

Between stations 95 and 108, distance a little less than 5 miles, fall 37 feet, ¾ mile of rock cutting, 10 feet deep, ½ mile earth cutting, 20 feet deep, and 1 mile embankment, averaging 20 feet in height, will be necessary.

From station 108 to 120, distance 4¼ miles, fall 7 feet. About ¾ mile of earth cutting, 10 feet deep, and ¾ mile embankment, 8 feet high, needed. From station 120 to 121, distance 2 miles, fall 12 feet, a very special survey is needed. The line passes across a shallow corner of the river for some 800 feet, and about 1 mile is along the face of very tortuous, broken, rocky bluffs, 60 feet high.

From station 121 to 126, distance 1¼ mile, rise 20 feet, ½ mile earth cutting, 10 feet deep, and ½ mile embankment, 10 feet high.

From station 126 to 138, distance 3¾ miles, grade line level, earth cutting 1¼ miles, 6 feet in depth, embankment almost nothing.

From station 138 to 175, distance 11 miles, the fall here is 17 feet in the first 4 miles; then the line rises 33 feet in the next 6 miles, crossing Willow creek on a level, and 13 feet above its banks to station 175. For the first 9¼ miles the grade line does not leave the surface at any point more than 10 feet, and for this distance 2 miles embankment, averaging 8 feet in height, and 1 mile earth cutting, 10 feet deep, is about the amount of work required. About 1 mile back of Willow creek the line passes along a rocky hill side, and from this point to the creek ½ mile of rock cutting, 10 feet deep, and ¼ mile embankment, 15 feet high, is necessary. Length of bridge across Willow creek 330 feet. Abutment foundations solid; pier foundations will probably require piling. ¼ mile embankment, averaging 6 feet in height, between Willow creek and station 175.

From station 175 to 196, distance is 4¾ miles, fall 15 feet. In the first ½ mile there is required ¼ mile rock cutting, 8 feet deep. thence up to station 196 the grade line does not anywhere vary more than 10 feet from the ground; for this distance 1 mile earth cutting, 6 feet deep, and ½ mile embankment, 6 feet high, necessary.

From station 196 to 211, distance 2¾ miles, rise 32 feet, embankment averaging 15 feet in height for one mile.

From station 211 to 215, distance ½ mile, rise 11 feet, excavation and embankment almost nothing.

From station 215 to 222, distance 2¼ miles, ½ mile of rock cutting, 8 feet deep. The fall between these stations is 26 feet.

From station 222 to 257, distance 6¾ miles, rise 35 feet, there is necessarily ½ mile embankment, 30 feet high, 2 miles embankment, 8 feet high, and ¾ mile earth cutting, 10 feet deep.

Between stations 257 and 258, distance 8¼ miles, the fall is 7 feet. The line here runs straight across a bend of the river on a low, gently undulating flat. There is nowhere cut or bank of more than 20 feet, and the material is all sandy earth. Over this section the level did not follow the line of location selected.

From station 258 to 273, distance 1¼ mile, rise 37 feet, about ½ mile embankment, 10 feet high, necessary.

Between stations 273 and 325, line level, distance 4 miles, is the Umatilla river. ½ mile embankment, 20 feet high, and ¼ mile earth, 5 feet deep, necessary. Length of bridge across the Umatilla 340 feet; solid foundation for abutments, and most probably for piers. The banks, down to the water's edge, being remarkably firm.

The section of the line from the Dalles to the Des Chutes river, a distance of 13 miles, presents far more of engineering difficulties than any portion of the same length up to the Umatilla. For most of this distance the bluffs are generally very precipitous, and near to the river; the peculiar basaltic formation in some places rendering anything approaching to an exact railroad location almost impossible, except from a very detailed survey; whilst in others the position for a railroad is so strongly marked that a very approximate location can be made without an instrument. It is in connecting these last mentioned portions with easy grades and greatest economy that the whole real difficulty, both as regards location and construction, lies.

Between the Dalles and Des Chutes river the ground—which of the whole distance to the Umatilla may be considered as most unfavorable for a railroad—amounts to nearly 8 miles, requiring in this distance probably 2,200 feet of tunnelling and 1,000 feet of bridging; whilst for the remaining 80 miles the sections presenting like difficulties amount to only 4½ miles.

With the exception of these 12½ miles, the estimate of the work required is quite approximate, most of the line being on broad, sandy flats or gentle sloping side hills. The rock is all basaltic, but, being much seamed and broken, is generally favorable for blasting.

It is also well suited for rubble-stone masonry, and ballasting, for which purposes material in abundance can be obtained from the debris of the base of the cliffs, which at some points has its natural slope for some 100 feet of vertical heights. Clear, sharp sand, of the finest quality, for building purposes, is in abundance at many points.

There is no timber along the line; a few small willows at long intervals, near the margin of the river, being the only wood. Pine timber, however, can be obtained on the Yakima, 12 miles from the Columbia; near the mouths of the Spokane and Pisquouse, also on the main Columbia; this can be readily rafted down the Columbia to any point of the line.

Pines and cedars are also found along the Clearwater, which can be brought down the Snake and Columbia rivers.

I am, sir, &c.,

C. R. HOWARD,
Civil Engineer of Military Wagon road Expedition.

Lieutenant JOHN MULLAN,
Commanding Military Wagon road Expedition
From Fort Walla-Walla to Fort Benton.

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., January 5, 1860.

SIR: In consequence of the illness of Mr. Howard, who was obliged to retire from the field, I was placed by you in charge of his party, and continued the survey of the Columbia and Snake rivers, from the mouth of the Umatilla river to the mouth of the Palouse, for Pacific railroad purposes.

The work was completed on the 31st of July, after which the party took up the line of march for your camp, which we reached on the 7th of August, on the Cœur d'Alène river.

During these operations the *personnel* of the party remained the same as when left by Mr. Howard. The level was run by Mr. Johnson, and the topography of the line was taken by myself. The instruments used were the odometer, engineer's level, and prismatic compass.

Previous to entering on the details of the survey, which I shall give as far as the time now at my disposal will admit, I would remark that on the portion surveyed by me, as on that previously surveyed by Mr. Howard, the question of grades, often so difficult a problem to solve, may be said not to exist—that is, they are so light as to cause no difficulty whatever. It is simply a question of curves and construction, or, in other words, to put in curves which will require the minimum amount of construction, all other things being considered.

This will be peculiarly the case at some of the points of basaltic rock which occur on Snake river, most of which project in the form of ledges, which can be easily taken advantage of for the road-bed.

The line of the river was followed throughout. No attempt was made at an *absolute* railroad location, but the best was done that the time and means at our disposal would permit. The profile and maps will show the character of the country, and the information gained will serve to guide future engineers to the most difficult points for more detailed examination.

The stations referred to in this report are the level stations marked on the profile, and commenced at No. 325, on the right bank of the Umatilla river.

At this point the line is distant about a half mile from the Columbia river, but reaches it again in a mile and a half, with a descending grade of 6 feet per mile passing over a sandy, earthen flat, and then takes along the river for 3 miles more, to station 363, on top of a rock ledge, and along a gentle sand slope, which admits of a grade of 10 feet per mile. At station 363 the line takes a steep, rocky side hill, with occasional perpendicular ledges, for 3½ miles, along the promontory called the "Monumental Rocks," to station 387, where they cease. The grade in this distance will not exceed 5 feet per mile, but will probably require, say, 1,000 yards of rock cut, 10 feet deep; the rest will be earth excavation, and curves will be from 2 to 3 miles radius. There is one large ravine, 300 feet wide, through which flows a small spring branch. This will require embankment, and a culvert of 6 feet span.

From station 387 to station 447, distance 5.4 miles, the ground falls 10 feet, passing over a rolling, sandy country, where there would be about 1 mile of embankment, 6 feet high, and the remaining distance cut; average depth, 3 feet.

From station 447 to station 496, distance 4.18 miles, the ground rises 15 feet, and will require very little work, except in the last mile, where there will be about 3,400 feet of embankment, 3 feet deep, and 800 feet rock cut, 30 feet deep, through a rocky point jutting into the river. The level line between these stations did not follow the selected line of location.

From station 496 for about 2 miles the grade will be very light—almost nothing. There will be 200 feet rock cut, 8 feet deep, and about 3,000 feet of embankment; average height, 5 feet.

A better line of location could, however, be probably found by throwing the line nearer the foot of the hills.

Thence to the Walla-Walla river, station 576, a distance of 3 miles, the country is rocky and broken. Points of rock jut into the river, and ledges of rock occur, cut up by ravines. The line will pass at the foot of these, with a very light grade. There will be about one-third of the distance embankments, 10 feet high, and two-thirds distance rock cut. A special and detailed examination will be required, in order to locate the line or make an estimate of the amount of work.

On the left bank of the Walla-Walla an embankment of 1,500 feet in length would be required, and 10 feet high; also a similar one on the right bank, for a mile.

A bridge, crossing about 100 yards above the mouth of the river, of 550 feet in length, would be required. Both banks are of sand, there being no rock immediately on them, but that material can be obtained in abundance from the neighboring cliffs. The river is very rapid, but fordable at low water.

From station 576 to station 587, or between the Walla-Walla and Snake rivers, a distance of 10¼ miles, the whole country is a sandy flat, almost level. There are but two elevations on it, neither of which are over 20 feet in height, and both can be avoided, as well as two or three gullies which occur, by throwing the line further from the river, towards the low range of sand hills which border it, at the general distance of three-fourths of a mile.

On each bank of Snake river an embankment of about 2,400 feet in length, and 10 feet in height, will be required. A drawbridge of 1,500 feet will span the river at a point about a quarter of a mile above its mouth. The river is about 16 feet deep at this point, in high water. Curves of 1,500 feet radius will probably be necessary to approach the bridge on either side, particularly on the right bank, where a range of hills about 100 feet high, following down the Columbia, come close on the bank of Snake river, about one-half mile above its mouth. This river was crossed by the survey at this point, and the right bank is the one always spoken of below.

From station 589 to station 598, right bank of Snake river, distance 4 miles, the line runs along the foot slopes of a range of sand and gravel hills, having the same general grade as the river, or not more than 4 feet per mile.

There will be two embankments, with drains, across the mouths of ravines, one 300 feet in length and 3 feet in depth, and another of 600 feet in length and same depth. Just beyond this station is a rocky point, which will require 352 feet of cut, of 35 feet depth. For the next mile, to station 601, the line runs on a flat, following the natural surface of the ground, and crossing a slough which will require a bridge of 75 feet in length.

From station 601 to station 632, distance 9 miles, the line, with the exception of about one-half mile, where it runs on a flat, takes the sides of gravelly hills, with slopes varying from 20° to 40°. No grade in this distance will exceed 10 feet per mile. The mouths of several ravines are passed—three of 50 feet in width and 3 feet deep, one of 30 feet wide and 10 feet deep, and one large one of 500 feet embankment, 25 feet deep, with culvert of 6 feet span. None have water in them, except in spring. The rock cutting between these stations will not exceed 40 linear yards; all the rest will be earth excavation. Along this portion of the line the river makes a very large bend northward.

From station 632 to station 635, distance one and three-eighths ($1\frac{3}{8}$) mile, the line runs for one-half mile along the steep side of a high rolling plateau, with a ledge of rock next the river, until a slough comes in, which makes a large bend towards the west, and cuts off a large gravel island. Beyond the slough is a high rolling flat, extending for a mile, to the foot of what is called "Anchor Cañon," where the river is enclosed on either side by perpendicular ledges of basaltic rock, rising directly from the water. The cañon extends from about station 646 to about one-fourth mile beyond station 663, where there is a deep ravine, and where it ends.

There are two distinct ledges of rock continuing all the way to the ravine, the lower one occasionally interrupted and narrow, and from 30 to 50 feet above the water.

These ledges are remarkably straight. All of this section from station 632 to station 646 will need a very special and detailed examination to ascertain the best and most economical location.

The most obvious would seem to be to cross the above-mentioned island, which would require two bridges of about 300 feet in length and embankment of about 1,500 feet in length and 30 feet in height, taking advantage of the rolling flat, beyond which is much higher than the island, to obtain the requisite grade, (which in no case would exceed 30 feet per mile,) and these pass the cañon on the upper or lower ledge, as may be found most advisable. There will be about $2\frac{1}{4}$ miles of heavy excavation and embankment, and about the same amount of rock cutting, 20 feet deep. Just beyond station 663 is a ravine about 500 feet wide, which will have to be passed, and a point of rock requiring a cut of 200 feet long and 40 feet deep. From this point to station 721, distance $7\frac{1}{2}$ miles, the line will run generally on the sides of gravel hills, with slopes of from 20° to 40°, with about a mile of rolling plateau. There will be some 7 or 8 large ravines requiring embankments of from 100 to 400 feet in length and an average depth of 10 feet, with culverts, and numerous small gullies only requiring drains. There will be about 4,000 feet of rock cutting, with an average depth of 6 feet, and about 600 feet of retaining wall. Grades very light, not more than 10 feet per mile.

From station 721 to station 738, distance 2 miles, will require a detailed examination to determine the best location. About $\frac{1}{2}$ mile consists of a rolling plateau, cut up by ravines on top, with two rock ledges at the base part ($1\frac{1}{2}$ miles) of a bluff, the face of which is composed of alternate broken ledges of rock and steep earthen slopes. The line on the profile gives the levels on top where the instrument was enabled to run, above which, again, are other perpendicular ledges or cliffs over 200 feet high. A line can be obtained along the face of this bluff by taking advantage of the ledges of rock and the use of retaining walls. It is impossible to give any definite idea of the amount of work, but most of it will be rock cutting. A tunnel would not be needed and the grade would not exceed 20 feet.

From station 738 to station 742, distance 1¾ mile, the line runs generally along the side hills, with slopes of from 20° to 30°, where the grade will be light. In this distance there are 4 ravines, embankments from 60 to 200 feet in length, and average depth of 25 feet, culverts four feet span. From station 742 to the Pine Tree Rapids, distance 3¼ miles, the river is bordered by steep hills and cut up by ravines. The lower portion of these hills consists of broken ledges of basaltic rock, points of which jut into the river.

There are 5 ravines which will require bridges or embankments of from 100 to 350 feet, and 2 which are 900 feet broad. There are rock ledges on both sides of all the ravines. The grades would be light. At least one-half of the work would be in rock cutting; the remainder earth excavation and embankment.

From Pine Tree Rapids to station 757, distance 3 miles, the line would run along a broken, rocky ledge with a descending grade of 20 feet per mile. This last station will have about 2,000 yards of rock cutting 10 feet deep, the rest being earth excavation on side slope of 1½ to 1. Three ravines are to be passed, 275, 300, and 350 feet broad on the line. This station will require a very particular examination, being probably the most difficult on the whole river. From station 757 to station 778, distance 1¼ miles, the line of location selected does not follow the line exhibited on the profile, but takes the bank of the river with an ascending grade of 15 feet. Two large ravines will be passed, requiring culverts of 10 feet span. From station 778 to station 783, distance 2 miles, the line has a descending grade of 10 feet per mile, and presents no difficulty, as it follows the course of the river banks on side slopes of earth, varying from 15° to 45°, and intersected only by two ravines of any size, requiring culverts of 10 feet span. From station 783 to station 797, distance 2½ miles, the line can be located either according to the line shown on the profile, or on either side of it, as may seem, on minute examination, the best line to approach a basaltic cliff, which juts out into the river. There is no difficulty whatever on any of these lines and no rock cutting. At station 797 the cliff commences and continues for about a mile. There are three ledges of rock running parallel to the water, but not continuous. Curves of 1,500 feet radius would be required at station 799, and the line can run around the face of the cliff on the lower ledge. There will be rock cutting for a mile with an average depth of 15 feet. This point will require a very particular examination. The grade will not exceed 10 feet per mile. Within the next half mile to station 799 there are 3 large ravines, which will require embankments of from 200 to 300 feet in length, and 20 feet in depth; culverts of 10 feet span. In the above-mentioned cliff the first ledge rises about 50 feet above the water, has an average breadth of 30 feet, and would be the best location for the road. From station 799 to station 822, distance 4 miles, the line runs on the side slopes of hills, varying from 10° to 30°. The grade will not exceed 6 feet per mile and the section presents no difficulty whatever. The mouths of 17 ravines are crossed, the largest being 150 feet wide and 10 feet deep, the smallest 30 feet wide and 8 feet deep; no rock cutting in this section.

From station 822 to station 825, distance 5½ miles, the line runs partly at the foot of basaltic cliffs, and partly at the foot of steep earth slopes crowned with basaltic rock. There is a regular beach of rock boulders along the whole of this distance, and the level line was run on this below high water mark. An embankment with retaining wall can be easily made at the foot of these cliffs, the total amount of which would be 1¼ miles and 15 feet high; besides which there would be about 600 feet of rock cutting, 5 feet deep. There are 4 ravines to be passed requiring embankments of from 100 to 400 feet in length and 12 feet high; the rest will be side-hill excavation.

From station 825 to station 836, distance 4½ miles, the line for 3 miles runs along gentle side slopes for 1½ miles; the side hills are at an angle of 45° and curved in one or two places with loose rock, where retaining walls would be necessary. The grades can be thrown above or below, as may be found best. There are 3 large ravines requiring embankments of from 100 to 150 feet in length and 10 feet deep. There will be about 200 yards retaining wall.

From station 833 to station 836, distance 1¾ mile, the line, as shown on the profile, was run directly across the sand hills to the mouth of the Palouse river, but would not be the selected line of location. Should the line go up the Palouse, to gain the table land, it would be thrown on the side hill above; or should it pass the mouth of that stream, it would keep below on the river bank, where it would run on gentle side slopes. The grades and amount of work would, of course, be widely different on the two lines; neither, however, would present any difficulty.

Bench marks were established at the Monumental Rock, at Old Fort Walla-Walla, near the mouth of that stream, and in two places, one near and the other at the mouth of the Palouse. All were cut in the solid rock, and the height above the base line engraved on the last one.

It will be seen by the above report that the survey made by me divides itself naturally into three sections: the first from the Umatilla (station 325) to the Walla-Walla river; second, from the Walla-Walla to the mouth of Snake river; third, from the mouth of Snake river to the mouth of the Palouse.

In the first section, distance 22¾ miles, there are 6½ miles of difficult work, rock cutting generally, and requiring a special examination to determine the best line of location. The rest is either side hill cutting or embankment in sandy earth, and presents no difficulty whatever. There will be 550 feet of bridging. In the second section, distance 10¼ miles, there is no difficulty whatever; the line will pass on a sand flat, the excavation and embankment will not exceed 10 feet in depth at any point where there is no rock, and no structures required except a drawbridge of 1,500 feet across Snake river. The third section, distance 59¼ miles, presents much greater difficulties than the others in consequence of basaltic cliffs and broken ledges of rock which occur at the several points mentioned in the above.

None, however, involve greater difficulties than have already been overcome on railroads in the eastern States, and all of these places can be passed without tunnels, and with easy grades. There will be 15½ miles of the above distance which will be nearly all rock cutting along these cliffs, and which will require a particular instrumental examination to determine the best grades with which to approach them, and the best location to pass with the least work. Of the remaining distance 39 miles will be in side hill excavation, with occasional rock cutting.

The location of the line will be very easy, and the character of the ground will admit of very light grades, the highest not exceeding thirty feet per mile. Embankments will be chiefly across ravines, of which there are a large number, and perhaps three miles across flats, with an average depth of 15 feet, depending on the location of the road.

The amount of curvature will be very great in consequence of the tortuous course of the rivers. The least radius will be 1,000 feet, and very flat curves can be employed with great effect in passing the basaltic cliffs to diminish the amount of work.

Basalt was the only rock found on the Columbia and Snake rivers within the limits of the survey. It was full of seams, much of it columnar, and will, I think, be easy to blast. It is excellent for rubble stone masonry and ballasting, and can be obtained in the greatest quantities; the finest quality of sand can also be obtained in great abundance. There are remarkably few springs above the level of the river, and the soil is generally sandy, but has an abundance of excellent grass, both on the river and the hills.

With the exception of a few willows of small size there is no timber on the Columbia and Snake rivers up to the mouth of the Palouse, within the limits of the present survey. Wood for railroad purposes can be procured, as is well known, from the upper Columbia, the Yakama, and the Clearwater, and rafted down; and it may not be irrelevant to remark that the location of the line directly along the banks of two large and navigable streams will afford unequalled facilities for the transportation of the men, their tools, provisions, and the iron and other materials for the road.

The right bank of Snake river was the one surveyed, as it was reported to offer the least obstacles to a railroad location. The left bank seemed to be more difficult, looking at it across the river, but it is almost needless to say that no final location could be properly made until both sides had been instrumentally examined.

I am, sir, &c.,

W. W. DE LACY,
Civil Engineer.

Lieut. J. MULLAN, *U. S. A.*,
Commanding Military Road Expedition.

FORT OWEN,
Bitter Root Valley, W. T., March 9, 1860.

DEAR SIR: On the accompanying tracing you will observe an approximate location and profile of a railroad line from the eastern base of the Bitter Root mountains, at Sohon's Pass, to a point some seventeen miles westward, where the line leaves the side hill and takes the valley of the Cœur d'Aléne river. This section comprises the points of chiefest difficulty in the vicinity of Sohon's Pass, as on the east of the mountain the line follows the valley of the St. Regis Borgia river with less of curvature and comparatively easy gradients.

Between the points first named there are estimated two tunnels, the main one through the mountains of 2.35 miles in length, and the other about two miles east of the South Fork, the length of which is 0.25 of a mile.

The curvature has been taken at a maximum. From the smallness of the scale of the map it was found convenient to use reversed curves in places where they were not absolutely necessary; and curves of 1,000 feet radius, in many instances, have been used where larger ones might be substituted.

Between the west portal of the main tunnel and the point where the line leaves the side hill (on the tracing marked *a*,) the distance is 14.70 miles, of which 6.45 are curved, and 8.25 straight. The air line between these points is 13.38 miles; lengthened by curvature 1.32 mile.

In the 6.45 miles of curved line the amount of angular deflection is 1600°, of which 89° 50′ are of 2,000 feet, 59° 21′ of 4,000 feet, and the remainder of 1,000 feet radii.

An inspection of the tracing, which was taken from a map made with great detail and accuracy by Mr. Kolecki, will show that several of the large ravines coming into the valley of the Cœur d'Aléne river from the southward can be crossed only at their mouths, and hence the grade lines are very approximately determined.

From the east portal the grade rises 10 feet in the first mile, and then descends at the rate of 75 feet per mile to the west portal; thence for 2.14 miles at 100 feet per mile; thence for some five miles at 80 feet per mile; and for the remaining 7.56 miles the grade is 70 feet per mile.

The base line of the profile is the level of the slackwater at Cœur d'Aléne mission, or 2,209 feet above the level of the sea.

From the point where the military wagon road commences ascending the mountain on the western side, (the western portal of the main tunnel,) there has been no detailed survey along the railroad line as indicated on the tracing, and further investigation may considerably shorten the tunnel line as here estimated.

I am, sir, very truly your obedient servant,

C. R. HOWARD,
Civil Engineer to Military Road Expedition.

Lieutenant JOHN MULLAN,
United States Army, Commanding Military Road Expedition
From Fort Walla-Walla to Fort Benton.

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 15, 1860.

SIR: I have the honor to submit the following report of my journey, undertaken pursuant to your verbal instructions in May last, to examine a route for a military wagon road across the Bitter Root mountains from the Sma-Kodle prairie on an east line to the Hell's Gate defile. Furnished with such information of the route as given by certain Cœur d'Aléne Indians, and as described by the missionary, the Rev. Father Josét, and with the hope and view of obtaining their assistance, I started from the Dalles without delay.

On the 3d of June I left the Des Chutes landing in the steamer Colonel Wright, and landed at old Fort Walla-Walla on the 5th, and reached the new fort on the 6th, where I found Messrs. Wiessner and Kolecki in charge of the astronomical observatory, when the latter informed me that he had already despatched an Indian expressman to the Cœur d'Aléne mission for the necessary guides for my trip.

Whilst at Walla-Walla I endeavored to secure the services of some Nez Percés Indians to accompany me to the Hell's Gate, but when I mentioned to them the particular route that I wished to examine, they represented to me that the whole region was one immense bed of rugged mountains, and over which they never heard of any persons having travelled, and therefore they declined to join my party.

On the 7th of June the Rev. Father Josét arrived, together with Augustine, a Cœur d'Aléne Indian, who had been sent for as one of my guides. This Indian declared that the contemplated trip could not be made yet, because the streams were too high, and the snows in the mountains too deep, and that it would be impossible to pass over the more difficult regions before some time in August. I insisted upon starting immediately for the examination, when Father Josét informed me that the other two guides, who were necessary for the examination of the route, had not yet been obtained, and that it was, indeed, doubtful whether they could be obtained. It evidently seems that the route in question, from the accounts of all, had not been a travelled one, and that no one knew the route continuously from the waters of the Snake river to those of the Bitter Root.

It would seem, however, that there were three Cœur d'Aléne Indians who knew the three sections of the route. These were Ko-ne-moo-say, Kah-lis, and Augustine; the latter knew the more difficult mountain sections and the higher ridges, and told me that he had discovered this section whilst hunting, and that he came in view of the Bitter Root valley about twenty-eight miles below the Hell's Gate defile, but that he did not descend into the valley. Father Josét told me that the other two guides were absent for reasons that I might account for. Augustine was apparently uneasy and displeased; first, because he disliked to show that portion of the country which he claims as his property, fearing they would lose it; nor was he at all anxious to undergo the fatigues and difficulties of the trip; but when he found that the absence of the other two guides would be sufficient to prevent me from travelling, he mustered his best will for the undertaking. He desired to go back to his family, promising to meet me at the camass prairie of the Cœur d'Alénes on the 20th of June, when he would join and guide me to some of the higher peaks of the Bitter Root mountains in his country, which, though probably covered with snow, we might ascend, and where I could have an extensive view over the mountains and country generally, and saying, "Then you can see all and satisfy yourself." As there was a probability of finding the other two guides at this same camass prairie, I decided to let him go, with the understanding that he would meet me on the 20th of June. While the reconnaissance from the Sma-Kodle prairie was thus retarded on account of my Indian guides, I determined to explore the line from the point where the military road crosses Snake river to the Sma-Kodle prairie. The map of this exploration has been compiled in the office this winter. In order that you may know the character of the country in detail, I make the following extracts from my itinerary, which were made in the field at the time:

June 14.—I ferried Snake river at the mouth of the Palouse and encamped; grass and wood scarce; my party consisted of Toohill, Frank Hall, a half-breed, and Slougharchy, the Palouse chief.

June 15.—Was cloudy and windy; we crossed the Palouse three miles above its mouth, and ascended a high and steep bluff to the table land; and from the point where your wagon road joins this trail we travelled about north 30° east, and encamped on the Palouse river at the point where Colonel Wright encamped when holding a council with the Palouse Indians in September, 1858; our march was eighteen miles; grass and wood in abundance.

June 16.—At 5 a. m. the weather was clear, with a temperature of 66° (F.); we travelled up the Palouse on the left bank for seven miles, when we struck the Smokle creek and followed it; it flows through a valley of easy grade, and bounded on either side by high rolling prairie, its course being generally east and west. The valley at its mouth is somewhat narrow, but in one-fourth mile it widens, and in five miles it runs out into the general level of the country. In eight miles from the river it is closed in again by slopes 100 and 600 feet high. The soil in the first ten miles is somewhat gravelly; further up it is richer, and in 15 miles it bears the camass and other roots, upon which the Indians subsist. In the first ten miles there is little or no wood, but higher up, cottonwood, aspen, birch and brushwood fringe the banks, more or less. At the mouth of the creek the water is some eight feet wide and two inches deep, and supplied mostly by a small tributary coming in from the south; but the creek is dry in many places, and hence, at times water might be scarce, though there are many springs that might be improved. Grass is plentiful along the whole route, and indeed the road is good, requiring but little grading along the valley of the Palouse for wagons to pass. This day we travelled twenty miles up the creek, twenty-seven from last camp, and encamped on the creek.

June 17.—Thermometer 52° (F.) at 5 a. m.; continued to follow up the valley of the Smokle creek; the valley is dotted with pines, and in many places cut up by narrow sloughs, now dry, but they would interpose no serious obstruction to the construction of a wagon road. In twenty miles our road joined a heavy trail coming in from the southwest, when it leaves the valley of the Smokle creek; and leading over a rolling prairie region, in eight miles it reaches a good spring of water, which is about 200 feet north of the trail, on a side hill. In three miles more it reaches the bottom of the Sma-Kodle which we ascended for two miles, and encamped at a spring, near a bunch of thornberry bushes, distance from last camp $34\frac{2}{10}$ miles. The creek winds through a flat, which is one-fourth to one mile wide, and in early summer, being under water, produces the camass.

June 18.—We followed up the Sma-Kodle prairie for seven miles, and encamped on the creek of the same name, and at a point where it joins to the northwest foot of the Tat-hu-nah hills. These hills are from 1,200 to 1,400 feet high and some three miles long. The top of the southern portion is sparsely timbered with pine; there is a ravine also near at hand which is timbered, and where a spring of water offers a good camping ground. The country to the south and west of the Tat-hu-nah is a rolling prairie, extending as far as the eye can reach. On the north and two miles distant is a mountain ridge covered with pine. The intermediate region is low and diversified by small spurs and prairie bottoms, which last connect with the Sma-kodle prairie, and it is through this gate that the road would pass in approaching the Bitter Root mountains from the west.

Towards the east the country for twelve miles is an undulating prairie, with scattering pines, when the western foot-slopes of the Bitter Root mountains are reached. These rise to the east and northeast in lofty peaks and spurs, covered with dense pine forests, while in the southeast they rise in masses of broken flats, and free from timber. I ascended the northern peak of the Tat-hu-nah to obtain a view of the distant ridges, but found them obscured by the haze of the atmosphere. June 19th I despatched Slougharchy, the Palouse chief, on an express to your camp, forwarding by him a map of the line travelled and examined up to date, whence I proceeded to the camass prairie in search of the Cœur d'Aléne guides.

Leaving the Tat-hu-nah hills we passed over a rolling prairie country in the general direction of N. 30° W., magnetic, for five miles, when we crossed a ridge five hundred feet high, and steep; in eight miles from Tat-hu-nah we crossed a small creek called Ki-ah-ne-mah; four miles more we ascended a ridge nine hundred feet high, and, in one and a half mile, descended to the valley of the Palouse river proper, here called the Mo-ho-lis-sah. The valley is here three-tenths of a mile wide, and timbered with pine. The river is thirty feet wide, two feet deep, with sandy bottom; its general course is west. At the distance of seven miles further we encamped on a creek where the water stood in pools; here the grass was good and wood abundant. The weather was exceedingly warm during the day, and severe upon our animals that were not in the best condition. Our march this day was nineteen miles.

On June 20th we started at sunrise; it was clear and pleasant, thermometer being at 50° Fahrenheit. The road continued over rolling prairie, when, in four and a half miles, it crossed the Ingossomen creek; in two miles further another small creek; thence ascending, in one and a half mile, a ridge of six hundred feet, descends, and, in four miles, reaches Nedl-whuald or camass prairie of the Cœur d'Aléne's—distance from last camp, twelve miles. The prairie is about one mile wide, and bordered by mountain spurs with pine forests.

On a flat elevation on the left bank of the Nedl-whuald creek was the camp of the Cœur d'Aléne Indians; it was at this time they were digging roots. Bands of horses were grazing in the bottom and along the creeks. This, then, was the appointed place and time for meeting the guides who were to conduct me in my exploration across the Bitter Root mountains. The guide Augustine was here, who, with other Cœur d'Aléne Indians, came out to meet me, and, pointing me to a spring near at hand, I encamped.

During the day the chiefs and principal men, who had been my old friends, visited me in camp and exchanged news. I soon learned that the services of my guides had not been obtained. One, Kah-lis, was absent, and Ko-ne-moo-sey, who was present, was in a doubtful mood, and told me, as an excuse, that we could not go now, as all the guides were not present. They were evidently excited regarding the construction of the military wagon road, and inquired anxiously concerning its probable location. Ko-ne-moo-sey said he thought we should take the Sma-kodle prairie route; but when asked to go as guide, he refused. I saw then, from the mood of the Indians, that their services could not willingly be secured, and their disposition was to retard my movements, obstruct my passage through their country, and have me consume a large portion of the summer in fruitless efforts at an examination. Without guides, without information, and in a region known only by its difficulties, and with Indians in their present mood, it seemed a useless effort for me to attempt to make a direct exploration of this special route that you sent me to examine and report upon. I disliked, however, after all my labor and expense of time and means, to leave the mountains without gaining some approximately correct information that would form the basis of your operation or subserve the purposes of future explorers. I determined, therefore, as Augustine was the more willing of the three to accompany me into the mountains, that I would avail myself of the oppportunity, and attempt to ascend some of the higher ridges of the Bitter Root range, and thus obtain a glimpse or view of the country, and thus arrive at some definite conclusion regarding its topographical character and formation. Therefore, on the 21st June I left the camass plain with feelings of some anxiety, though determined to do the best I could with the means and aid at my disposal. Before leaving camp, however, the old Cœur d'Aléne chief, Skah-ha-e-mu, called to see me, and said that his people had held a council the night previous, and, passing around the pipe, had remained up late arguing the question whether Augustine should be permitted to accompany me or not to the upper country. The majority prevailed in my favor, though Ko-ne-moo-sey was against it. Augustine was present and heard the conversation, and appeared indignant at the idea that his people should interfere with him. He started willingly, though lamenting the difficulties that we should meet with in ascending the ridges, where we would have to climb for days over steep side-hills where the ground was obstructed by dense forests and fallen timber, and even now covered with snow. Starting out we travelled up the open prairie valley for three and a half miles, thence through open timber for three miles, when we crossed a low spur and descended to a creek, which we crossed and encamped on its right bank.

There was good grass in the open timber. June 22d started at sunrise, weather clear, thermometer 42° (F.) Our route lay through open timber, and in 5½ miles along a side-hill, and following up the right bank of a small creek, a tributary to the Nedl-whuald, and in a mile more we crossed it at the junction of two branches, thence over a ridge covered with dense forests, fallen timber, and underbrush, and in 2½ miles, or nine miles from our camp, we reached a camass prairie, two miles long and half a mile wide, closed in by mountain spurs densely timbered. We followed a small creek, which joins in this prairie a second creek that rises from the south, and which together formed a stream 20 feet wide. We passed along the main creek through a narrow valley, on a good road for four miles, when we crossed it. Then the trail leads over a low ridge one mile, and then for 1½ mile to the north of a ravine that leads into the valley of the south fork of the St. Joseph's river. We crossed the St. Joseph's, and encamped on its right bank. Distance travelled, 25 miles. The river here is 80 feet wide and two feet deep, with a gravelly bed and swift current. The valley is 3-10 of a mile wide and densely timbered. Our animals had sufficient grazing along the edge of the river and in places where the timber was less dense. June 23d we moved up the south fork of the St. Joseph's eastward, crossing three creeks, and making six crossings of the main river, and encamped on a camass prairie five-tenths by two-tenths of a mile in area. This prairie is along the river, and at the foot of the high ridge for which we were travelling. On June 24th we rested in camp, for our animals were now weary and fatigued, and we thought it best to halt and prepare for our task of ascending the ridge. All had gone well up to this point, but here our evil genius seemed to have attended us in the person of Damass, the brother of my guide Augustine, whom we met hunting in the mountains. After a series of endeavors and intrigues on the part of Damass, he succeeded in changing the mood of his brother Augustine, who then determined not to accompany me further. He came to me and said as follows: "Let us have a better understanding. I told you at Walla-Walla that there was no road through this section to the Flathead country; the mountains are too difficult. Those high ridges yonder (pointing to some high spurs of the Bitter Root range) are small compared to those over which we shall be compelled to pass, and there are many of them: the road would pass over high and steep mountains, and down in steep ravines and cañons. If all the Americans would work here a thousand years they could never make a road. I think a road through the Pend d'Oreille country is the best for you, for there you do not pass over difficult mountains. It was Ko-ne-moo-sey who told you that a wagon road could be had here, and he says this because he owns land along the Pend d'Oreille route, and fears if the soldiers make a road along that route he will lose his land. I am sorry to see Father Joset and yourself determined to take this route. Those who told you that a road could be had here deceived you, and made you lose time in exploring. I say again, that if all the Americans would spend a thousand years here they could not make a road." And finally he said, "I think you would do better to return from here." This conversation with my guide showed me that he was determined to go no further, and that all endeavor would be now useless. My animals were jaded, provisions scanty, and even in this extremity I should have tried to continue the exploration further, had I not perceived that even he feared some mischief from his brother, who desired to detain me until other Indians should join them, for they daily expected others from the main body. You have, then, my reasons for returning, and though I did it reluctantly, it was my safest alternative to rescue my small party from the hands of men whom I now could trust no longer. I returned to the Sma-kodl prairie, where I found encamped the Nez Percés, and some other tribes, who where here digging camass. They met me in a friendly manner, but could give me no information relative to the proposed route; but they all regarded it as a matter of impossibility to discover a wagon road route south of the one that you had originally proposed, following *via* the Cœur d'Aléne mission and St. Regis Borgia river. Among the Indians whom I met here was "Three Feathers," whom I had often met in the mountains before; we gathered in his lodge to exchange news, &c. It was here I met the old chief Yah-moh-moh. The old man, not knowing my exact object in this region, began speaking very freely regarding the mountains. He said, "When young he hunted in this region and found plenty of game, water, and grass were abundant, and travelling good." I then asked for a guide to show me the section he spoke of, and for the hire of a few horses. "Three Feathers" replied, "Wait, you will get plenty of horses." I left the lodge and invited them to come and see me in the evening. They did so, and dined with me, when, bringing up the subject of the road, I was only surprised to find that their opinions now were just the opposite to what they had expressed in the morning. I would remark that a portion of the route would have to go through their country. The old man made an energetic speech, declared his friendship for the whites, &c., but described the mountains as formidable, the forests and underbrush as impenetrable, and the streams dangerous, if not impassable, &c., and implored me not to think of exploring the route—that if I did I would perish, and rumor would say that the Indians had killed me. He thought the route by the Cœur d'Aléne mission the best. The consequence of all this was that I could obtain neither horses nor guides. Never have I seen Indians more impertinent or unwilling to do service of any character; I could not even secure the services of one of them to bear you an express. I desired Augustine to return with me, but his brother Damass told him that you would hang him. Thus you will readily see the circumstances amid which I found myself, and the peculiar trying difficulties of my position. I then determined to despatch

Frank Hall with an express to you, mounted on my best horse, and abide your further instructions, and, as you are well aware, notwithstanding all the difficulties around us, I was still willing to undertake the exploration of the line embraced from the Tat-hu-nah hill to the Hell Gate defile, which you thought might be practicable. I satisfied myself of one thing: the extreme aversion that the Indians have against any wagon road passing through their country; and I have no doubt but that it affords a constant theme for conversation and discussion among them. I remained in camp at the Tat-hu-nah hills until the 3d July, awaiting the return of Frank Hall, who on that day arrived with an express from you, directing myself and party to start for your main camp, where I arrived and reported to you on the 7th July, 1859.

I am, sir, respectfully, your obedient servant,

G. SOHON,

Guide and Interpreter Military Road Expedition.

Lieut. JOHN MULLAN, U. S. A., *Commanding Military*
Road Expedition from Fort Walla-Walla to Fort Benton.

FORT OWEN, BITTER ROOT VALLEY, W. T.,
March 7, 1860.

SIR: In compliance with your instructions to examine the valley of Snake river upwards from Fort Taylor to Red Wolf's Crossing, I left your camp at the mouth of the Tukanon creek on the morning of July 1, 1859, with one man and three horses. The Indian trail leading to the Red Wolf's or Al-pah-hah Crossing follows the north bank of Snake river, which, offering less difficulties for horses, I crossed the river at your camp and took the above-mentioned trail, following it upwards to the place of my destination. Snake River valley, as far as I ascended it, is entirely destitute of timber, and the enclosing bluffs are also naked, and only covered with bunch grass, giving quite a monotonous aspect. The valley itself gains gradually more the character of a cañon, and the bluffs become, in the same degree, more rocky and precipitous, and afford more difficulty to the location of the trail. At the top of the bluffs the surface gains the form of long, rolling plateaus, cut up by steep ravines, which extend backward from the river from four to six miles, many of which, in spring, contain running water, heading in the plateaus. These tributaries to Snake river are not very large, but are of great importance to the Indians, who, by this means, irrigate their fields, which they have established at every little point where the valley extends and the soil promises to yield a crop. The Indians are so anxious to profit by every piece of ground fit for cultivation that islands and even portions of islands are used for this purpose. Besides wheat and corn, they raise vegetables of different kinds, and gain sufficient crops to encourage them in their labors. The soil, generally, does not appear to be rich in the valley, being gravelly and sandy, but the plateaus on both banks produce fine grass, offering magnificent pasture grounds.

The cultivated ground, amounting to from 300 to 400 acres, is distributed in seven farms of more or less extent, the lower two of which belong to the Palouse Indians, and the remainder to members of the Nez Percés tribe. The river flowing between Red Wolf's Crossing and Fort Taylor in a semicircle, convexed towards the north, bends little in itself, but where it does, forms sharp curves, occasioned by projecting rocks springing out from the bluffs. The average width of the stream is 350 yards at the stage of water in July, and I noticed only one place, about 13½ miles above Fort Taylor, where for one and a half mile it reaches a width of 500 yards. The current of the water is very rapid, but I am unable to give its velocity. I think, though, that it is about the same as observed by Mr. Weisner at Fort Taylor. No obstruction of any consequence exists to its navigation for the whole distance of 65½ miles, and the only rapid which extends from bank to bank, situated about four and a half miles above Fort Taylor, is far more insignificant than all those below the mouth of the Palouse river. At four other points, all situated above the last-mentioned place, the river forms small rapids, extending partly across the stream, leaving a large space of water unobstructed for shipping purposes.

Snake river, in comparison with other large streams west of the Rocky Mountains, forms but few islands; the only one of any extent on the portion of it seen by me is 25½ miles above Fort Taylor, and just below the first Palouse farm; this is an island of one mile in length and a half mile in width, covered with luxuriant grass, used by the Indians for pasture ground when the side-hill grass has been dried up by the summer's heat. The main channel of the river passes the southerly shore of the island, which, in fact, is only divided from the main land by an arm of water not exceeding 25 yards in width. Besides this largest island I counted 13 others, all of which, but one, are above the lower Palouse farm. The depth of Snake river must be great, and at all stages of water above fording; its bed is gravelly and in some portions rocky. Below Alamote creek, which is 39½ miles above Fort Taylor, five small creeks empty into Snake river from the north, and two from the south. Six miles above Alamote creek, where the upper Palouse farm is established, the second large creek, named Awanwi, empties into Snake river, just above the first Nez Percés farm. From the west bank of the Awanwi creek, the Nez Percés race-ground extends along Snake river for one and three-quarter miles. This is a level, but gravelly, tract of land, with a soil too barren to produce even sage brush. From Awanwi to Skalaissams creek the distance is 15 miles, in which interval four more small creeks empty from the north side into Snake river. Skalaissams creek, running in the ravine which the trail from the Red Wolf's Crossing towards the north follows, heads four and a half miles from its mouth, which last is about two and a half miles below the mouth of the Al-pah-hah creek. At Al-pah-hah creek a tribe of Nez Percés, under their chief, Timothy, have a permanent village, with houses constructed of buffalo skins and mats, supported by a light frame-work. I was friendly received by Timothy's son, Edward, ferried over, and treated to salmon, which fish is caught in great numbers in the waters of Snake river. Opposite the mouth of Al-pah-hah creek is a high, rugged, and timberless mountain, called Tailuts, which overtowers all others. This mountain, standing in the course of Snake river, has forced that stream out of its way, causing it to make two abrupt turns to get around its base. At the mouth of Al-pah-hah creek is a spring, known to the Indians as Al-pah-wah spring, which is said to contain some healing power.

Snake river being, as above stated, entirely destitute of timber, the Indians living along its shore have to depend entirely for fuel upon drift-wood, which, at every freshet, is deposited in great quantities by the water along the river shores, and then carefully gathered by the Indians. The valley of Snake river is so cañon-like that it would be very difficult to construct a wagon road in it for that reason alone; but, then, the absence of timber would almost make it an impossibility for railroad purposes; those difficulties would be increased by the sudden sharp curves which would involve long, rocky excavations, or the construction of bridges across the wide and rapid stream. Wagons proceeding to the upper Nez Percés country will find an easy road, along the north plateau, if they keep far enough from the bluff's edge to head all the ravines, water and grass being plentiful, and also wood in patches. Leaving Red Wolf's Crossing without being able to procure a guide, on the morning of July 4 I resolved to follow the plateau road towards the Palouse river, even without assistance, rather than return with my tender-footed animals over the rocky river trail. By information I had learned of a trail leading in that direction, and concluded to hunt for it, and return by it to your camp; the trail in question gained the plateau by the Skalaissams ravine, which is four and a half miles long. The trail in the ravine is bad in places, but, compared with the generality of mountain trails, is a good one. In four and three quarter miles I gained the top of a small prairie ridge, and in one and three-tenths miles further I struck a broad trail forking towards the west, which I thought was the one spoken of by the Indians. After following it for nine and two-tenths miles, and passing four fine springs and a trail leading from the river towards the north, the trail I was travelling gave out, when I concluded to turn and follow the trail which I crossed, three and four-tenths miles back, in search of Mr. Sohon, whom I knew to be encamped at Tat-hu-nah hill. It was 2½ p. m. when I lost the trail, and I had to travel fast in order to reach Mr. Sohon's camp before night, as my provisions were almost exhausted, having started with only two small loaves of bread and a few pounds of boiled meat, which last was spoiled by the heat on the first day out from your camp. In ten and a half miles I crossed a prairie ridge 400 feet high, and six and a half miles further struck a small grove, which I recognized as a camping place of Mr. Sohon, on Sma-kol creek, as indicated on his sketch, of which I had a tracing with me. Still pushing on, I crossed, in three and seven-tenths miles, Sma-kol creek, after having passed Camass prairie. From the crossing I went over a small prairie ridge, and after a ride of forty-one miles encamped on a creek which contained, in holes, bad tasting water. No bush or sage brush was to be seen to which our animals could be tied, and we had to turn them loose. Mosquitoes and gnats were innumerable, and kept our horses moving all night, so that they had disappeared the next morning, and were only found after a search of many hours. Knowing now where I was, I determined to take Mr. Sohon's road, along Smokle creek, and try to reach your camp that night without hunting up the camp of Mr. Sohon, who might have moved from Tat-hu-nah hill. Following down Sma-kol creek, on its right bank for five and two-tenths miles to the crossing point, I struck in one-half mile more the trail travelled by Mr. Sohon, and reached in eleven and six-tenths miles Smokle Creek valley, which I followed down for ten and five-tenths miles. At this spot I found an Indian lodge, and obtained, for a few rounds of ammunition, some tea and salmon. Resuming our march, on the afternoon of the 7th July we encamped on the Smokle creek, after having descended it for fourteen and seven-tenths miles; the day was very hot, and my horses quite fatigued, having made 42 miles. The next morning I started at daylight, and joined your camp, on the Palouse river, at 10 p. m., after a march of 19 miles.

The valley of Smokle creek having been described in Mr. Sohon's report, I think it unnecessary to refer to it here.

Very respectfully, your obedient servant,
P. M. ENGEL, *Top'l Engineer.*

Lieut. JOHN MULLAN, U. S. A., *Commanding Fort Walla-Walla and Fort Benton Military Road Expedition.*

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 8, 1860.

SIR: In obedience to your orders to examine the Palouse river and the adjacent country, regarding its adaptability to the construction of a military wagon road, I left the main camp, near the Smokle creek, on the morning of July 7, 1859, accompanied by Mr. Spangler and Donnald McKay, our interpreter.

Over the first nine and a half miles, to the mouth of the Oraytayoose, we passed rapidly, as this portion of the country was known to you from personal observation, and therefore commenced our investigation beyond it.

Having crossed the Palouse about half a mile above the junction of the Oraytayoose, at the same place where the military road crosses it for the last time, we found that 300 yards further up the stream the edges of the table-land bordering the valley of the river approached either bank very closely, forming a rocky defile half a mile in length, sparsely timbered, even impassable for horses. We therefore left the river and ascended on a tolerably easy grade to the top of the table-land on the right bank, which attains a height of about 350 feet. As far as we could see, the country presented a high, slightly undulating prairie, destitute of timber, with here and there an isolated long, narrow ridge from 100 to 250 feet above the general level. The principal depression therein, the valley of the Palouse, was very distinctly marked by its rocky bluffs and scattered groves of timber.

For a short distance we kept on level ground; thence descended on a pretty steep grade again into the valley of the river, the character of which remained almost uniform for the whole distance, we had an opportunity of examining it. It is a quarter of a mile wide, much winding, its main direction E.NE. The river flows through it in a serpentine course, first touching one side and then the other. The banks on the outer side of these bends form, invariably, a more or less precipitous bluff of basaltic rock from two hundred to four hundred feet high, according to the elevation of the table-land itself, and covered with scattered pine. The banks on the river sides are generally plateau, from ten to thirty feet above the surface of the water. The current at and near these bends is swift; the depth of the water from two to three feet; the bottom big boulders. Above and below them the current is hardly perceptible, and the water very deep.

We found a trail, and followed it along the right bank of the river for seven and three-tenths miles ($7\frac{3}{10}$,) alternately passing steep side-hills and level plateaus, to a point where it crosses and leaves the river, keeping in the valley of a small creek. We nooned in a little grove of tall pines very conveniently situated near the crossing for the benefit of travellers. While our horses were enjoying the luxuriant bunch grass on the side-hill, we feasted on sarvice berries, wild currants and gooseberries, which grow there, as in many other places along the river, in the greatest abundance. After a short rest, Mr. Spangler and myself proceeded along the river. Donald McKay kept on the trail to find out its direction. About four miles from this place we came to a considerable bend of the river, and saw, in a northwardly direction, the mouth of an immense cañon with perpendicular basaltic walls from six hundred to seven hundred feet in height. One mile further we passed its entrance, and concluded, by the appearance of the country, that at some former period the river must have flown through it. At present, it contains but little water, the bottom being marshy only in a few places, which were indicated by the growth of low brush.

Above this bend the topographical features of the valley slightly vary. The rocky bluffs become much higher—from four hundred to five hundred feet, and are of much greater extent—one mile or more long. The plateaus opposite are much narrower, and finally form only the lower portions of a gradual slope from the top of the table-land to the river. The bottom land intervening widens, is extremely fertile, covered with tall grass, cottonwood groves, and wild currant bushes.

Late in the evening Donald McKay joined us, bringing the intelligence that the Indian trail followed up an easy valley near and almost parallel to the Palouse, but much more direct.

Three miles from the entrance of the basaltic cañon, or fifteen miles from the starting point of the examination, we camped for the night in a rich bottom.

So far, there existed no material difficulty to the construction of a wagon road.

Immediately beyond our camp, though, there was a rocky bluff, some four hundred feet long, which could not be avoided on account of the marshy ground on the opposite side of the river. At daybreak, July 8, we continued, still along the right bank, as the easiest of the two. In three and a half ($3\frac{1}{2}$) miles, crossed a small creek coming from the northward. Half a mile further on we were compelled to cross over to the left bank, on account of the rocky bluff on the right bank being impassable. Beyond this point we had to cross at every bend. The valley generally became very difficult, and altogether impracticable for a wagon road; the rocky bluffs abrupt, from five hundred to six hundred feet high; the bottoms either swampy or timbered; and the crossings deep, with very large boulders. In the same degree as the physical obstacles increased the scenery became more beautiful, and somewhat diversified, at every bend of the valley. Once I tried to proceed on the top of the table-land, but soon convinced myself that the innumerable ravines intercepting it in a short time would have broken down our horses and impeded our progress much more than the crossings. So I again descended into the valley, repeatedly crossing the river, through fertile bottom lands, some a half or even three-quarters of a square mile in width, and occasionally climbing along rocky bluffs until I struck the eastern Spokane trail, which crossed the river at a point nearly fourteen miles distant from our camp of the previous night. We took a short rest to avoid the greatest heat of the day and to give our horses an opportunity to graze.

Some Spokane Indians whom we found there encamped behaved very friendly towards us, but could give no information in regard to the character of the country ahead of us. By all appearances, though, it seemed reasonable to suppose that the current of the river further up was rapid throughout, and the valley nearly approaching a cañon with but very small patches of bottom land.

To reach the Pyramid Peak in the shortest time, we left the river entirely, and ascended the steep face of the table-land on the northern or right bank. For three and one-third ($3\frac{1}{3}$) miles we rode on the trail in a northerly direction in a gradually ascending valley formed by low prairie ridges. Gaining the top of a cross ridge at the end of that distance, we obtained a view of the Pyramid Peak; as the trail did not tend towards it, we struck for it, across the rolling prairie, in a straight line. In seven miles we reached a bottom near the foot of the peak, where we found a series of cool springs, greatly to the delight of ourselves and animals. The sun was but a few degrees above the western horizon, we were much fatigued by the long march, and, therefore, rather disposed to delay the ascent until morning; but the delicious coolness of the atmosphere succeeding, almost instantaneously, the heat of the day, inspired us with new energy, and we climbed up this steep and rocky cone that stretches its crown more than one thousand feet above its dingy neighbors.

From the top we had a view of the whole country for eighty (80) miles around us. The outlines of all objects were, for a short time, very clearly defined by the last rays of the setting sun. The Blue Mountains, the high table-land stretching from new Fort Walla-Walla to the Columbia, and beyond it the mountains around the Cœur d'Aléne mission and lake, and the Bitter Root mountains, were distinctly visible. The information regarding the particular object for which I was sent out was by no means satisfactory. I merely convinced myself that the topography of the country, as developed by Mr. Sohon on various expeditions, was correct. The Palouse, as far as I could see, followed an east and west course. The spurs of the Bitter Root mountains, from which it proceeds, were gently sloping and densely wooded. Pine timber, in scattered groves, reaches from them to within four or five miles of the foot of the Pyramid Peak.

The whole country enclosed by the above-mentioned mountain systems is rolling prairie, very much resembling a stormy sea. We camped half-way between the summit and the foot. The water we carried from the springs below, and collected dry firewood on the northern slope, which is covered with small bushes. The nights were extremely pleasant, certainly much warmer than one might have expected. On the morning of July 9 we ascended once more for the double purpose of taking some necessary compass bearings and enjoying the sunrise, which beyond doubt offers one of the most interesting spectacles. These objects being accomplished, we retraced our steps to the Palouse river, crossed it, kept on the Spokane trail, which ascended the opposite table-land and leads towards the south, and in three and a half (3½) miles struck an extensive and very rich bottom, the same that Donald McKay had examined for some four or five miles on the first day of our trip. We followed it down in as rapid a gait as our horses could endure, and at intervals of from six to seven miles we found good springs and small groves of cottonwood. Within five miles of the Palouse the springs became more frequent, and finally formed a small creek which empties into the Palouse at the crossing of the trail, at the place where we nooned on July 7.

There could be no route more desirable for a wagon road than this bottom offers, and as I have stated before, that no material difficulties exist between it and the last crossing of the Paloose, near the mouth of the Oraytayoose. I would consider it as favorable a location for a military road as could be found in this region. This opinion, of course, holds good only so far as I went myself. Beyond the Spokane trail the bottom continues. Whether it contains sufficient water, or whether the connexions with the valley of the Palouse are easy, I cannot decide upon, although I suppose the difficulties would not be great.

To avoid the rocky bluffs of the Palouse valley below the junction of this bottom, we crossed over the table-land, which would be a much better location for a wagon road.

Towards evening we reached the last crossing of the Palouse, where we found the whole command encamped.

I am, sir, respectfully, your obedient servant,

THEODORE KOLECKI,
Topographer.

Lieutenant JOHN MULLAN,
In charge of Fort Walla-Walla and Fort Benton Military Road.

FORT OWEN, BITTER ROOT VALLEY, W. T.,
March 16, 1860.

SIR: Having received, on the 29th of July, your instructions to examine, in company with Mr. Kolecki, the two forks of the St. Joseph's river, from the point where the military road crosses the same, we proceeded on that day to carry out your orders, and on that date reached the forks of the main river where we found a camp of Cœur d'Aléne Indians. Finding it impossible to travel along the forks on horseback, we made an arrangement with the Indians to take us in bark canoes to the foot of the high mountain which we saw at a distance of about 16 miles; but the price which they demanded for their services appeared to us too exorbitant, and we returned to your camp at the crossing of the St. Joseph's river for further instructions. Receiving your sanction to our plan to ascend the river in canoes, Mr. Sohon (whom you had detailed for this special survey instead of Mr. Kolecki) and myself started, July 30th, for the Indian camp. Finding three bark canoes in readiness for us, we started, and after ascending the north fork of the St. Joseph's for eight and a quarter miles we reached a little creek called "Innemassequilam," running around the foot-slopes of the mountain, which we intended to ascend the next morning, as this was the nearest point to the peak to be gained by water. We landed, encamped and prepared for the morrow's journey. The character of the river is the same as observed by you at the military wagon road crossing, the water being deep with scarcely any current. The banks are low, but steep. The river winds its way through a narrow valley, touching alternately each side of the high mountain spurs, forming, in places, small prairies, some of which contain lakes, or are cut up by little creeks, bordered by berry bushes. The Cœur d'Aléne Indians consider this portion of the country the richest berry region in the mountains, and visit it regularly towards the end of July and the commencement of August.

July 31.—Mr. Sohon, myself, and one Indian ascended to-day the mountain, but before reaching the summit we were convinced that we would have no distant view, and therefore retraced our steps. At one p. m. the smoke of the burning timber enveloped the whole country, and our Indian guide assured us that we would have no view until after a heavy rain. On returning the Indian set fire to the woods himself, and informed us that he did it with the view of destroying a certain kind of long moss which is a parasite to the pine trees in this region, and which the deer feed upon in the winter season. By burning this moss the deer, in winter, are obliged to descend into the valleys for food, and thus they have a chance to kill them. We remained during the night at Innemassequilam creek and returned, August 1, in canoes to the Indian camp, and from there on horseback to your main camp on St. Joseph's river.

Very respectfully, your obedient servant,

P. M. ENGEL,
Topographical Engineer.

Lieut. JOHN MULLAN, U. S. A.,
In charge of Military Road Expedition
from Fort Walla-Walla to Fort Benton.

Report of a reconnaissance of the country between In-chats-khan camp and the lower portion of Spokane prairie and the portion of Spokane river between the Cœur d'Aléne trail and the Colville wagon road ferry, by P. M. Engel, topographer.

FORT OWEN, BITTER ROOT VALLEY, W. T.,
March 8, 1860.

DEAR SIR: Receiving your instructions of September 19, 1859, respecting an examination of the country between some point westward of Pown lake and the Spokane prairie with the view to the location of a wagon road, I was delayed until the 24th of September by continued rain-storms at the main camp of the party on the ten-mile prairie, on Cœur d'Aléne river, at which date I started with one man, two riding and two pack animals, and camped on the Cœur d'Aléne river, six and five-tenths miles west of the mission. I had to remain there the next day—my animals having strayed off—being found only late in the evening. On September 26 I reached St. Joseph's river crossing; at evening it began to rain, and continued to do so for the night and next day, obliging me to remain in camp. On September 28th I crossed the St. Joseph's river and followed the wagon road towards In-chats-khan, at which place I camped. The Cœur d'Aléne Indians, who were encamped along the St. Joseph's river, annoyed me considerably in stopping me repeatedly with the view of obtaining some presents.

September 29 commenced with rain. I started early and followed the In-chats-khan creek valley downwards for six and three-quarter miles on its right bank. There I crossed the creek and kept the left bank for one and a half mile, at which point I made two crossings but a few yards apart from each other. The direction of the valley to this point is south 86° west. No obstruction of any description would offer itself to the location of a wagon road; the low prairie hills, which for the first mile and a half closely hug the creek, recede, after that distance, and leave a valley bottom of half a mile in width. The creek, lined with brushwood, contains water only in holes; but the winding bed is cut deeply, showing at different places the sign of a strong water current in high-water season. Large open pine timber covers the low hills which produce fine bunch grass. The above-mentioned first crossing of the creek cannot be avoided, as the creek makes a bend towards the north and keeps close to the hills from which its waters have washed off the foot-slopes, transforming them to a perpendicular cut of ten feet in height. The two following crossings can be easily turned, occasioning only a detour of eighty to one hundred yards. In a mile and a quarter lower down the road would enter the open timber, and half a mile from there a crossing to the right bank would be necessary at the same point where the trail crosses, and then follow that bank for a mile and three-quarters to a place where the trail leaves the In-chats-khan valley and takes a more northwesterly direction. At the place where the road leaves the valley a small ridge of a mile and a half in width, with easy ascent and descent, lying between two parallel running tributaries of the In-chats-khan creek, has to be crossed. Here a little timber cutting will be found necessary, principally on the descent. In-chats-khan creek, a tributary of Lah-too creek, is nine or ten feet wide, and has, at the point selected for crossing, a gravelly bed which, at the present season, is scarcely covered with water. From the foot of the above-mentioned little ridge the road would lead for three miles and a half over undulating ground covered with open pine timber to a third tributary of the In-chats-khan, and in two and a half miles further over country of the same description, would strike a fourth one, which runs in quite a broad bottom, part of which is miry and would require some corduroy work; three-eighths of a mile from this point the trail forks; a wagon road would follow the north fork to save an angle made by the left-hand trail, which strikes the fifth tributary of In-chats-khan creek, a mile and three-tenths below the crossing point of the upper trail. From the forking point the trail strikes the said tributary in two miles and two-tenths, and the lower one in a mile and nine-tenths. I followed the lower trail to reach camp as soon as possible, as it had been raining all day, and we were drenched and cold. This little water run affords good camping places with plenty of water, wood, and grass. The valley is from 180 to 200 yards wide, enclosed by low hills covered with pine timber; the creek itself being lined with willow and cottonwood. Made 22 miles to-day.

September 30.—Ascended the valley for one and one-tenth mile; I struck the point of the upper trail, and one-fourth of a mile from there left the valley, ascending an easy divide of 250 to 300 feet, the top of which I gained in one mile. The descent is as gradual as the ascent, but somewhat more densely timbered; but by removing a few trees any wagon could be brought down to the creek which flows one and one-fourth miles from the top of the divide in a narrow valley. At this point the road has to descend the creek in keeping on its left bank to a place where the pine timber disappears; there it will ascend the low and gently sloping side-hill, and strike, following almost an air line in five and four-tenths miles, the Spokane river, opposite the termination of the bluff running behind Antoine Plant's farm. From this point the road can follow the Spokane river on its left bank until within five miles of the place where it leaves the river altogether, and striking over the mountain pass towards the Fort Walla-Walla and Colville wagon road. No obstruction of any moment will be found to bring wagons over, even in the present natural state of the ground; whereas, on the right bank, some considerable work will be unavoidable. Mr. Kolecki having already reported to you regarding this latter section of the country over which the road would have to go, I think it unnecessary to do so. The Spokane river, which I crossed at Antoine Plant's house, I found to be eight feet deep in the channel, and big boulders in its bed. My animals having strayed off, I remained the next day at the farm, and started only October 2 for the Colville depot. I camped that night at the Spokane fishery, near the mouth of the Little Spokane river, a distance of twenty miles, having taken the shortest route to gain that point.

October 3.—I started early, but having mistaken the trail I travelled for about ten miles in the direction of Pend d'Oreille lake, and only then finding that I was wrong I had to retrace my steps; but making a short cut I gained before evening the Spokane river, about ten miles below my last night's camp, and in three more marches arrived at Colville depot, where I was kindly received by the officers of the post.

On October 12 I made a survey of the wagon road from the Colville depot to the Hudson Bay Company's fort. This road leads through Pinkneyville, and then along Morigeaus creek, passes the saw-mill two and a half miles distant from the depot, and, following the creek which winds around a high mountain, gains in six and seven-tenths miles from the depot the junction of the lower or low-water road which runs for some distance through Mill Creek valley, and becomes practicable for wagons only late in the season. From the point of junction the distance to the Hudson's Bay fort is seven and two-tenths miles, making a total distance of fourteen and two-tenths miles from place to place by the upper road, which is a natural one; and I doubt whether any work has been done on it, with the exception of a few corduroy bridges which were constructed during the summer of 1859.

At Colville I was hospitably received by Mr. McDonald, the gentleman in charge. In returning the next day I extended my sketch a little by going to the old Colville mission and to the Kettle Falls of the Columbia river, and then following the wagon road to the grist-mill which is located on Mill creek, about one and a half mile above its mouth, at the forking point of the lower and upper roads; I took the bottom road, and, having run a compass line over the whole distance, I found the lower road two and one-tenth miles shorter than the upper one.

At Colville I learned that Commissioner Archibald Campbell, of the northwest boundary survey, with party, was shortly expected, and that there was a possibility that he might go down the Columbia river in open boats. I therefore determined to await his arrival, knowing that you were anxious and intended to have that important stream surveyed from Fort Colville to Fort Walla-Walla. Mr. Campbell, who arrived on the 16th, found that the preparation of the boats would occasion a long delay, and preferred, for that reason, to make the trip by land. Having obtained permission from Mr. Campbell to travel with his expedition, I started with him and Mr. Warren on the 20th October. In three marches we reached the lower end of Walker's prairie, where Mr. Campbell was unfortunately delayed for a day by the straying off of his team mules. I pushed on and camped on the Spokane river, three miles above the ferry. I took advantage of my presence in this part of the country to run a compass line from the ferry to the place where the lower Cœur d'Aléne trail to Colville leaves the Spokane river, knowing that this section had never been surveyed. I found the distance between the two points seven and three-tenths miles, of which four miles are rendered difficult by the closing in of the side-hills; but just above the ferry a company has commenced the building of a bridge which was not completed at the time I passed. The day was so foggy and rainy that I hardly could see across the river which runs in quite a narrow valley, walled in by steep, rocky hills. Open pine timber covers the valley to the very edge of the water which has a swift current over a rocky bed. Having made twenty-six miles I encamped on a small creek three miles west of Antoine Plant's house. At the latter place, which I reached on the morning of October 25, I took an Indian to guide me to the Cœur d'Aléne mission, where I arrived on the evening of October 28. Reverend Father Gazzoli kindly offered me the accommodation of the mission, and supplied me the next morning with oats which I needed for my weak animals, knowing that I would find no grass between the mission and your camp, which I was informed by the Reverend Father had been pushed to the east side of the divide. Making two more camps on this portion of the road, I joined your party October 30, on the five-mile prairie, on the St. Regis Borgia river.

I am, sir, very respectfully, your obedient servant,

P. M. ENGEL,
Topograpical Engineer.

Lieutenant JOHN MULLAN,
United States Army, Commanding Fort Walla-Walla
and Fort Benton Military Road.

Report of reconnaissance of Little Falls of Spokane river, and the country along the right bank of the Spokane river, from Colonel Wright's crossing to the Colville wagon road, made August 27 *and* 28, 1859, *by Theodore Kolecki, topographer.*

SIR: On August 26, while at the Cœur d'Aléne mission engaged in transit observations with Mr. Wiessner, I received an order from you to examine the Little Falls of Spokane river, and make a topographical connexion between our work of last year and the survey of the Colville wagon road made this year by Mr. Engel, provided I had leisure time to do so.

We had just finished a lunation, and before we could make use of the next one, four, probably five, days would elapse, giving me just time enough to fulfil this order. Therefore, without further consultation, I set out at one o'clock the same afternoon, provided only with the most necessary means which I could scare up at the moment. An Indian guide was my sole companion. Our store of provisions consisted of three loaves of bread, weighing about nine pounds, and a small quantity of coffee and sugar. For want of a pack animal we carried a couple of blankets each on our riding horses.

The valley around the Cœur d'Aléne mission was filled with smoke produced by fires in the woods on the surrounding mountain ridges. The trail to the crossing of the Wolf's Lodge creek, which I had carefully surveyed last year, and found extremely difficult on account of the fallen timber, was almost impassable in several places, as many more trees had fallen down, and a large fire was raging in one of the most thickly timbered bottoms, where, in consequence of the richness of the soil, the trees attained a height of from 200 to 300 feet. It was not without a great deal of vexation and imminent danger to our horses that we got around this scene of destruction. I think it took us an hour and a half, and when we struck the trail again it was fairly dark, still we were very glad having escaped unhurt, and pushing on as fast as possible we reached the Wolf's Lodge creek and prairie—the only camping ground within sixteen miles of the mission—at half past eight o'clock in the evening. Throughout the whole night the deep roar of the immense fire continued at short intervals, interrupted by the loud report of falling trees, similar to a sharp, distant peal of thunder.

Shortly after daybreak, August 27, we were in the saddle, and continued our march over the picturesque mountain spurs touching the northern shore of the Cœur d'Aléne lake. At the uppermost ford of the Spokane river the dimensions are as follows: 427 feet width from beach to beach; 100 feet from beach to high-water mark on the left bank; 70 feet from beach to high-water mark on the right bank; 7½ feet height of high-water mark above present level; at 90 feet from north beach depth 2¾ feet, velocity 44 feet in 37 seconds; at 180 feet from north beach depth 4 feet, velocity 44 feet in 38 seconds; at 270 feet from north beach depth 3 feet, velocity 44 feet in 33 seconds; at 360 feet from north beach depth 2 feet, velocity 44 feet in 35 seconds.

Half a mile below the first bend, three-quarters of a mile below the farm of the old chief Tonnère, and all the way from the point where the trail leaves the river down to the Little Falls, are rapids with big boulders, and no more than one or two feet of water. I estimate the average fall from the lake to the falls, a distance of eight miles, to be twenty feet per mile. The above-mentioned points will be readily found on my map of last year. At the Little Spokane falls the river breaks through a low ridge of granite, which connects the mountain ranges on either side of the river, forming a cañon or chasm about 900 feet in length, averaging 60 feet wide, the rocky partly overhanging wall on the south side being 80 feet; the one on the north side 60 to 70 feet high, and at the commencement of the chasm is a perpendicular fall of about twelve feet. The channel is not more than 50 feet wide and divided into two parts by a high longitudinal granite block projecting but a few feet above the present level. The bank on the north side is formed by an almost isolated rock 75 feet long, 100 feet wide, and 24 feet high, with many smaller and larger cracks or rents parallel to the course of the river, through which a small quantity of water finds its way even at the present stage of low water. This latter circumstance permits the suggestion that in course of time this principal obstruction to the river in high water will be worn away even without artificial aid. The force of the constant flow of water is exemplified by round deep holes worn into the granite rock near the foot of the falls. Above the falls the river forms a lake-like extension with but little current. Below the falls, as far as the chasm extends, the water seems to be deep and the current very swift, boiling over large pebbles beyond it where the river again spreads to a width of from 200 to 300 feet. The high-water mark at the falls I estimated to be eighteen feet above the present level. A full understandtng of the nature of the country in the immediate neighborhood I hope can be arrived at by a careful perusal of the sketch accompanying this report.

Late in the afternoon I pushed on to attend to the second part of my instructions. In about six miles I reached Colonel Wright's crossing of the Spokane river. The ford is good, the river bank neither steep nor high. For eight miles a wagon road would go over the almost level Spokane prairie to a bluff near Antoine Plant's house, where the river so closely touches the plateau bordering the prairie that grading for 300 or 400 feet would be required. The mountain system of which it forms part undoubtedly consists of granite, but on its face, as well as in the river, are basaltic cones from twenty to thirty feet in height, and about the same diameter at their bases; they, however, appear to be a conglomerate of basaltic fragments very firmly cemented together.

Here we encamped for the night; early next morning, August 28, we proceeded on a large beaten trail leading through the prairie at a short distance from the river. The ground is covered with many boulders of considerable size. In two miles we again touched the river and passed for 500 or 600 feet around the foot of two low projecting spurs, and through a dry water run between them. Here, also, some work would be required in order to pass these points with wagons. One mile and one-third further is another ravine of a similar nature, but not quite so difficult to pass. In six-tenths of a mile passed the last spur of the mountains to the northward; the river tends for several miles to the southward, forming below the next bend the "Great Falls." The prairie extends for many miles to the north; for the next two miles the ground rises gradually, and at the end of that distance is covered with timber which reaches down to the Spokane river. Four miles from the commencement of the timber we encountered the edge of a low plateau and the same basaltic cones which I mentioned near Antoine Plant's; the ground now was a little undulating, and gradually sank for four and a half miles, when we reached the edge of the timbered plateau and descended about 200 feet into the bottom of the Spokane river; the trail is almost wide enough for a wagon road and not very steep, so that, I think, with little work the passage of wagon trains could be effected. This bottom is quite extensive on the south side of the river and wooded; on the north side it is bare. A considerable tributary draining the mountain region in the northwest joins the Spokane river at the junction of the Spokane fishery, an establishment of the greatest importance to the Indians, as the great quantity of salmon caught there with but little trouble forms the principal portion of their food. A number of lodges of the Spokane Indians and a few of the Cœur d'Aléne, Pend d'Oreilles, and Colville Indians are found throughout the year at this point. In justice to the Indians, I must observe that, with the scanty bounty provided them by nature, they are liberal to all passers by. We crossed the tributary which, by the Indians, is also called the Spokane water, (Sin-ho-may-ney-say-oolk.) We passed for at least 600 feet around a steep spur which, for that distance, touches the right bank of the river. Thence we continued through a narrow timbered bottom, the river on one side and the steep slope of quite high mountains on the other; in two and seven-tenths miles from the descent into this bottom of the fishery we again ascended to a wooded plateau 250 to 300 feet high. The trail kept on it for six and seven-tenths miles in a very direct course. To the northward extended a rocky ridge attaining a height of some 3,000 feet. The valley of the river to the southward was one to one and a half mile distant; its opposite bank is timbered table-land 500 to 600 feet high. The ground for this whole distance presented no other difficulty but one ravine which is some eighty or ninety feet deep. The descent into the river bottom is pretty steep and about 300 feet high. For one and one-fifth mile the trail keeps along the river, crossing some small dry water runs, and then ascends again to cross a mountain pass which is, according to my estimation, 1,000 feet high. The distance from the eastern foot of the mountains to the summit is four and a half miles; the grade for the first 300 feet is very steep, and in its present state, without being worked, would be impassable for wagons; the remainder is very easy. The descent to Walker's prairie on the western foot of the mountains in which the Colville wagon road is located is by some 300 or 400 feet less than the ascent, but the distance is also shorter, being about three and one-fourth miles; there is, however, but a short distance of side-hill and one ravine which would require some work for the construction of a wagon road. The mountains on either side, especially to the northward, attain a considerable height; they are composed of granite and quartz. The layer of fertile soil is some two or three feet deep and would greatly facilitate the grading of a road.

I presume that thirty good working men, properly directed, could, in one season, make the route I travelled a good wagon road. The map accompanying this report points out more in detail distances, differences in elevation, and the nature of the adjacent country. I reached the Colville wagon road just at sunset on the 28th of August. The ignorance of my guide, who said there was no water within a day's march, while there actually flowed a small creek at a distance of 1¼ mile, compelled me to retrace my steps over the mountains in the darkness of night, with horses that were almost broken down. At 10 o'clock in the evening we reached the Spokane river and encamped; one of the most beautiful northern lights I ever saw adorned the sky during the greater part of the night.

August 29.—I called on Antoine Plant for some provisions, as my bread had entirely given out, and I had yet two good days' march to reach the Cœur d'Aléne mission; he could spare me only two small loaves of bread, each weighing about two pounds, and a little butter. I asked him also for fresh horses, but he had none at hand. With the greatest pleasure I would have returned by the St. Joseph's and Cœur d'Aléne rivers, in order to avoid the fire beyond the Wolf's Lodge creek, but with so limited means and broken down horses I had no choice but the shortest road; for the night I encamped on the Spokane river several miles below the Little Falls.

August 30.—I reached the Wolf's Lodge creek early in the afternoon, the difficult trail and the still raging fire compelled me to encamp; our horses got a little rest and good feed, and the next morning, while yet the influence of the night dew kept the fire down, we pushed them on as hard as we could along the trail, through the burning timber, and thus escaped unhurt.

In the afternoon (August 31) we reached the mission without provisions and with horses hardly able to move. I regret that I did not fully understand all your views in regard to this expedition, which was intended to extend to the exploration of the country between the St. Joseph's and Antoine Plant's. With a little more time and a better supply of provisions I could have made this special exploration for a wagon road route, and thus saved the expenses which the trip of Mr. Engel, a month later, occasioned.

I am, sir, very respectfully, your obedient servant,

THEODORE KOLECKI, *Topographer.*

Lieutenant John Mullan,
United States Army, in charge of Military Road from
Fort Walla-Walla to Fort Benton.

Report of a reconnaissance from the Cœur d'Aléne mission to Thompson's prairie, on Clark's fork; thence to the St. Ignatius mission; thence along the left bank of Clark's fork to Horse Plain; thence across the mountain to the Bitter Root river; thence up the St. Regis Borgia river, and over the high divide to the Ten-Mile prairie, on the Cœur d'Aléne river.

Fort Owen, Bitter Root Valley, W. T.,
March 9, 1860.

Sir: Having received on the 18th of April, 1859, your instructions regarding an exploration of a road across the Bitter Root mountains towards Thompson's prairie, on the Clark's fork of the Columbia, which had been described by different persons as probably practicable for wagons, I left your camp at the Cœur d'Aléne mission on the same evening, accompanied by two Cœur d'Aléne Indians with three riding and two pack animals.

At the Four-Mile prairie of the Cœur d'Aléne river, where your working parties under Messrs. Williamson and Spangler were encamped, I joined the party of Mr. Sohon, who started for an exploration of the country towards the Bitter Root valley, and kept company with him until the morning of August 21, when we parted; leaving the Cœur d'Aléne river trail, about 25 miles east of the mission, and following my Indian guide, we took a northerly direction ascending a tolerably steep ravine, with running water, and enclosed by high thickly timbered ridges. The little creek, which is crossed and recrossed many times by the scarcely visible trail, heads three miles from the place where I left the Cœur d'Aléne river trail, and one mile to the northwest from the point where my present trail leaves it, which ascends a very steep ridge densely covered with pine treeps. In 1¼ mile I gained the summit of the ridge, which has an elevation of 1,500 feet above the Cœur d'Aléne river. To the right of the trail runs a narrow ravine, connected by a low saddle, with another running down the north slope of the ridge; those two ravines could be used for the location of the road, but the removal of rocks of the fallen and standing timber to the mouth of the narrow ravine would occasion considerable labor. At the top of the ridge I saw two valleys before me, divided by a high ridge, both of which contained running water, which join at the termination of the ridge. In 4½ miles, over a very dangerous trail along the steep mountain slopes, I gained the first creek, which we ascended. After crossing the creek, which is ten feet wide, I took the opposite mountain; commencing here the ascent, all signs of a trail disappearing, we had frequently to use the hatchet to open the way for the animals, and finally had to cut the entire road, the young timber being so dense that not even a man could have passed through. In this laborious manner I pushed on until late in the evening, having made but 2½ miles since I crossed the last-mentioned creek, but gained an altitude of about 2,500 feet. I camped on the mountain slope in a large patch of whortle-berries, which proved to be quite an acceptable substitute for water. I was forced to tie up my animals to have them at hand early in the morning.

August 22. Started 5.10 a. m., ascended 700 feet higher, using the hatchet again for one-half mile, then followed along the slope of the ridge, about 500 feet below its backbone. Rock-slides, fallen timber, and slippery grass, made this an exceedingly difficult road. In 1½ mile we found a little spring on the hill-side, and my Indians proposed to encamp, to which I gladly acceded. It appeared to me that the Indian whom you had employed as guide was a little uncertain about the way to proceed. He had only travelled over the trail once, in winter, on snow shoes, and the different appearance of the ground, with its difficulties exposed, evidently puzzled him. Not understanding his language, I could only converse with him by signs; but I easily comprehended that he wanted me to halt, to give him time to examine the character of the ground ahead. I furthermore understood that we had to follow the crest of a high, rugged ridge, the southerly slope of which is one rock-slide from top to bottom, which lay before us at a distance of about six miles. How to bring my animals over it was not quite clear. Alexis, the guide, left camp as soon as I had cooked breakfast, and Nicholas, the second Indian, collected the animals, which, at the risk of their lives, were clambering along the rocks to collect their scanty food. The country was filled with smoke, and no extensive distant view could be gained; but I could discover in the chasm below me the only place where the wagon road could be located; the fallen timber and rocks were piled above each other to a considerable height, and the creek boils over and through them.

The opposite ridge was well timbered, steep, and about 3,800 to 4,000 feet high, and closes in so narrowly with the ridge forming my road that no valley bottom at all is left. Towards evening clouds gathered over us, and at nightfall it began to rain. Alexis returned towards supper-time and gave me to understand that the road ahead was bad.

August 23. I remained in camp, as it was still raining. I had to alter the cruppers of my pack-saddles, which injured my mules, and had to make some alterations in the rigging generally. In the afternoon a heavy thunder-storm passed over a portion of the mountain-bed, but broke against the highest ridges, and the heavy clouds disappeared almost in the same direction from whence they came. Alexis started out again to make a further examination. It cleared off at noon, but the atmosphere is still filled with smoke and haze.

August 24. Started 6.47 a. m. The day was warm and clear, but the atmosphere still filled with smoke. In 2¾ miles I gained the top of the ridge, ascending it gradually, finding the same obstructions in the road as heretofore. Keeping along the very backbone of the mountain, which, at places, is not wider than two or three feet, I reached in 5¾ miles more the highest point, which is a granite rock formation of about 3,500 feet high, with a perpendicular rock bluff to the north, and a rock-slide of 60° grade to the south. On the north slope hard packed snow, from two to four feet in depth, fills up the ravines, and covers the ground in many places where it has been drifted during the winter. Four ponds, the largest one at the foot of the highest rock, gave a pleasant relief to the monotonous scenery. A dense pine forest covers all the northerly ridges which extend towards Clark's Fork, forming an immense mountain bed, only the outlines of which can be seen indistinctly through the smoke. To the south the main ridge, which gets steeper and steeper, approaches more and more, though not so rugged as the one I am on. It is more heavily timbered, however. The next three miles we passed over the worst road I ever travelled in my life. The ridge runs out to a rocky crest, which gives not more than from one to two feet footing. Sharp rocks, intermixed with loose stones packed upon each other, made every step insecure, and we had to proceed with great care. For two-thirds of the distance the north slope forms a precipitous rock wall of 1,000 to 1,500 feet elevation. With hard labor we built a kind of road for the animals, by removing the biggest rocks and steadying the loose stones in the most narrow places. The descent to the low divide is steep, but no rock slides are in the way, and we gained it in ¾ mile and camped on the head spring of the creek which waters the valley. We made to-day only 12 miles, but spent ten hours on the road. The animals were much exhausted, and so was I. We found good grass at the divide, which itself forms a low saddle connecting the two high ridges.

August 25. Started at 6.39 a. m. We had to gain the top of the ridge again, as it was found impossible to follow the valley, which was rendered impassable by fallen timber and rocks. In 1¾ mile we reached the summit again, advancing and ascending gradually, and discovered from there that the low hill forming the divide had a width of only ½ mile, and that the two head springs, sending their waters in opposite directions, were situated at the foot of said hill. The road on the ridge was much the same as yesterday, and at one point it was so bad that the Indian guide proposed to try the valley once more. We therefore descended, but, before reaching the bottom, saw it was impossible to get along in it, and had to retrace our steps. Two of my horses rolled down part of the mountain at the point where we tried to descend, and one of them got badly hurt. I observed two large ponds on the north side of the ridge, and also an abundance of snow. The timber on the ridge we followed is increasing, which, with the fallen timber, will augment my difficulties in getting along. 3¾ miles from the point where I gained the top of the ridge, I commenced the steep descent formed by a long spur running towards the creek bed, which I reached in 4½ miles. In some places the slope was so steep that the animals had to slide, bearing down by their weight the small pine trees and bushes which thickly covered the ground. The creek at the foot of the ridge is 25 feet wide, carries a large quantity of water, and runs in a rocky bed, which is closely hugged by the mountain on both sides. At the point where I struck and crossed the creek a densely timbered flat borders it on the east side, and over this my way led for 4½ miles. Having made 14 miles, I went to camp, as it was getting dark and my animals appeared to be much fatigued.

August 26. Made a late start, my animals having strayed off during the night. The road to-day leads along the creek, sometimes taking the side hills, but for the main part keeping in the bottom, which is much encumbered by brushwood and fallen timber. I forgot to mention that in striking the creek I also struck a small trail, which was so blind that even my Indians lost it frequently during the day. Shortly after leaving camp I crossed a small tributary to the main creek, coming from the south, and one mile lower down a second one from the north; 3¾ miles still lower a large spring branch, heading in the creek valley itself, forms a bad slough of one-fourth mile in width. The foot slopes of the enclosing high ridges leave little room to the valley, and the creek winding from side to side forces the trail often over the little spurs. I could not form a good estimate of the altitude of the main ridge on account of the dense smoke, which allowed only occasional glimpses of their tops, but I should judge that they were at least 2,500 feet high. I had hoped to reach Clark's Fork to-day, but a heavy thunder-storm which overtook us forced me to go to camp at 3½ p. m., having made sixteen miles. An extensive fire was raging on the Clark's Fork, and has extended high up on the creek that I was following. All the grass is burned, and my animals are badly off for food. At night the mountains presented a magnificent picture. The rain and wind had driven off the smoke, and fire lines, extending high up on the mountain slopes, reaching, in some places, to the very tops of the ridges, and in others spreading with surprising rapidity over the fire furnishing surface, gave a most fascinating aspect to the landscape.

August 27. Starting at 6½ a. m. I passed in ½ mile a large tributary, coming from the northwest. The main creek itself, now a considerable stream with an exceedingly rapid current, sends its boiling water over huge rocks, which gives the bed the appearance of an unbroken rapid. In 1¾ mile below the camp I crossed the creek with great difficulty. The water's depth was 3½ feet, and the bottom consisted of one smooth bed, covered with a slippery moss, which the transparency of the water permitted to be seen most plainly. The high ridges, which fall back, indicate the approach to a large valley, and also the suddenly changed course of the creek, which, so far, has followed a northeasterly direction, and now suddenly curved towards the northwest. After crossing the creek I travelled for 1½ mile over high rolling ground well timbered with pine, which has much suffered though from the late fires. I crossed then a small creek, which empties two miles below my crossing point into the large creek which I just left. In 1½ mile further I struck the shores of Clark's Fork, after having wound my way through a bed of rocky cones, which have a height of from 40 to 50 feet, one-fourth mile above the place where I struck the Clark's Fork. The current here is obstructed by a large rapid, which must be called a waterfall of eight feet. The opposite shore was pointed out to me as Thompson's prairie. In 1¼ mile more I found a suitable camping place, with some grass along the water's edge.

The opposite shore is in full blaze, and the wind blowing from the west drives the flames unfortunately in the direction which I have to follow. Several deer are forced to swim the river, in order to escape the fire, which extends to the water's edge.

August 28. Remained in camp. During the morning we collected material to build a raft, and before noon had constructed a kind of floating structure, very fragile, indeed, but my Indians think it is more than strong enough to do its duty. The fire is still raging on the opposite shore, but has extended more towards the north.

August 29. In two trips I landed everything safely on the right bank of Clark's Fork, and after having swum the animals, took up our line of march along the shore of the river, which has a width of 200 yards. In three miles I reached a small but rapid running creek, which we crossed at its mouth. On the left bank of the river is a high, almost perpendicular rock, connected with the high river ridge, which gradually has neared the river shores by a well-timbered slope of 1,500 feet elevation. The right shore forms a large plain, which, from the water's edge to the bluff, must have an extent of three or four miles; but I could not make an estimate of its width, as everything is enveloped in smoke. In 1¾ mile from the creek, crossing the rocky bluffs of the right bank close into the river, and renders the trail difficult for three-fourths of a mile. The road is then easy for four miles, and is only now and then difficult by thick brushwood. At the end of that distance I crossed a small creek, and two miles higher up I struck a point, which will be well remembered by all who have ever passed it, called the "Bad Rock." It is formed by a rock point running out to the very water's edge, terminating there in a perpendicular bluff. The Indian trail, which, in its present location offers undeniably great difficulties to the animals, winds high up on the bluff's side, and regains, in the same serpentine manner, the bottom about 300 yards above the place where it left it. I am confident that, with comparatively little work, a good wagon road could be made, but it would require blasting for a distance of 150 to 200 yards. In 3¾ miles, which were made over almost a level road, with the exception of the last three-fourths of a mile, where the trail passed a few insignificant, low, rocky spurs, I gained a little creek, where I camped, having made 16 miles.

August 30. Started at 6.50 a. m. In 1½ mile from camp the low foot-hills of the high river bluffs close into the river at a point where I noticed another river rapid, and which renders the road somewhat rocky for one mile, but offering no serious obstacle. The opposite mountain ridge has been getting lower and lower, and has finally dwindled down to a low hill range. The high bluffs of the right bank recede and give place to a large, extensive flat, which only in some places is covered with open pine forest. Having reached the "Kootenay" trail, I left the river, and shaping my course more northeastwardly gained the Indian road leading to the Camass prairie. This portion of the country having been often described in former reports, I confine myself to the recapitulation of the main ground features. Little or no difficulty will be found to bring wagons over this portion of the route until the ravine is reached which leads downwards to the Camass prairie; there heavy grading for one mile will be necessary, as the hill-sides are steep and the soil is intermixed with rock. Having ascended the steep river bluff, which is 150 feet high, I reached, in 1¾ mile, the top of the low timbered plateaus which run along a valley bordered to the northward by a ridge 1,100 to 1,500 feet high. The plateaus are covered with small rocks and now and then rent by a depression in the ground. In 4½ miles I reached a lake of one mile in extent, partly covered with weeds, and sending its waters through the above-mentioned ravine towards the Camass prairie, where it sinks in the ground. A plateau which runs along the foot-slopes of the ridge, which gradually increases in height and finally gains an altitude of 1,200 feet, terminates at the lake, from which point the trail leads over foot-hills for 2¼ miles, and then takes, after crossing the creek, to the north slope of the ravine. Of the different trails which lead over the Camass prairie I chose the one which runs along the southwesterly border, which is marked by a timbered ridge of about 1,200 feet. In one-half mile from the mouth of the ravine I crossed the creek and then travelled for 6¼ miles, over almost level ground, to the top of a small prairie elevation. In 1¾ mile further I crossed a creek running in a valley, with easy ascent and descent, and two miles further gained the valley of Clark's Fork by a gradual and easy descent, at which place I found a well-beaten trail, which led to the river crossing. We tried the ford but found it too deep, and I concluded to ascend the Flathead river to its intersection with the Jocko river, and make a crossing there. Having made $24\frac{8}{10}$ miles, I went to camp one-fourth of a mile above the place where I struck the river. My Indians seemed to be uncertain in which direction to proceed, but, having a map along, I soon convinzed them by signs that we had to ascend the valley in view to gain the St. Ignatius mission.

August 31. Started at 6.53 a. m. One-fourth of a mile above camp I crossed a creek which runs in a narrow ravine, and heads about three miles to the north on the Camass prairie. 1¼ mile above that creek the river widens to double its extent, and is split up by a number of islands of different sizes and well covered with brushwood. Here my Indians again tried to cross, assuring me that the road was much better on the opposite side; but the depth of the water forced us to turn back, and taking up our road again, we had to mount a high river bluff with a steep and rocky descent. Then skirting along the water's edge I gained, at 5¾ miles from my last night's camping place, a fine bottom of three miles in length, again hemmed in by the river bluffs. For 1½ mile the trail gains a plateau which, after rounding a projecting rock, strikes the river at the usual fording place, two miles above the mouth of the Jocko river. Here I crossed with much difficulty, and not without drenching my packs. Instead of ascending the valley to the Jocko river, as my Indians intended, I ascended the Clark's Forks for $1\frac{1}{4}$ mile further, and then followed Plum creek, knowing that it was the shortest route to reach the mission. At the entrance of Mission creek into Plum creek I struck a large lodge-trail, which brought me to the place of my destination. I was most kindly received by the Rev. Fathers Minetrey and Louis, and hospitably invited to stay as long as I desired. I made to-day $21\frac{5}{10}$ miles. My animals were very tired, and two of the horses I shall be obliged to trade off.

September 3. Rev. Father Congiato arrived from Fort Benton, and left September 5th. I left the mission in company with Rev. Fathers Congiato and Minetrey, who intended to visit the Cœur d'Aléne mission. In $4\frac{1}{2}$ miles I struck the Jocko river, and after crossing it I followed down Clark's Fork, on its left bank, for $16\frac{4}{10}$ miles, and encamped, having made $20\frac{9}{10}$ miles. The road along the river is a very good one, with the exception of one point, where a mountain closes in for a quarter of a mile. The ground is firm, and not rocky. The small creeks, with gravelly bottom and fine grass along their shores, afford good camping grounds.

September 6. Started 6.44 a. m. The trail, after passing the crossing point opposite the place where the road leading towards the Camass prairie ascends the bluff, becomes more and more indistinct, as it is very seldom travelled by Indians; many rocky and swampy places make the road a difficult one, and a bad rock spur, the perpendicular foot slope of which is washed by the river, forces the trail over a high and stone-covered mountain, which is almost as bad as the "Bad Rock" above Thompson prairie. In two places, where no ascent to the ridge can be gained, and the river runs close to the bluffs, the trail leads along the river bed with a depth of water from two and a half to three feet. At a point thirteen miles below the Camass prairie trail crossing, I struck the Bitter Root river, which appears to flow through a narrow valley enclosed by high mountains, and effected a crossing at the junction of the two rivers without any difficulty, and following down Clark's Fork for $7\frac{1}{4}$ miles further, which portion of the road is good, and only made disagreeable to travel by the dense brushwood, I camped on the shores of the river, and on the upper end of the Horse Plain, having made $20\frac{9}{10}$ miles.

September 7. Started 7.27 a. m., and took a straight magnetic southerly course, to gain the top of the mountain ridge which forms the divide of the waters of Clark's Fork and the Bitter Root and St. Regis Borgia rivers. The ascent and descent are, in some places, very steep, and rendered difficult by fallen timber, but the trail is well-marked and broad. The distance from river to river I estimated at $10\frac{1}{2}$ miles, and the height of the ridge at 1,500 feet. Ascending the Bitter Root river valley for eight miles, in which I met with no difficulties on the road, I went to camp, having made $18\frac{5}{10}$ miles. I observed two small rapids in the Bitter Root river, and counted two creeks, both of which empty on the left bank.

September 8. One mile above camp I left the river at the crossing point, and striking over a little divide towards the St. Regis Borgia encamped on this latter stream, after a march of 26 miles.

September 9. I ascended the river valley to the foot of the big divide and encamped, having made 15 miles. It has been raining all day, and we expect to find snow on the top of the divide.

September 10. I crossed the divide to-day, and, as predicted by the Indians, found the top covered with snow. From base to base of the mountain I estimated the distance 24 miles. Descending the Cœur d'Aléne river for six miles I encamped on a small prairie, and had the honor to report myself at your camp on September 11.

Knowing that a more detailed and careful survey would be made at a later period, when the military wagon road would have been located and constructed over the country, I deferred running a compass line from the crossing of the Bitter Root river, westward, to your camp.

I am, sir, most respectfully, your obedient servant,

P. M. ENGLE, *Topographer.*

Lieutenant JOHN MULLAN,
United States Army, in charge of Fort Walla-Walla and
Fort Benton Military Road Expedition.

CANTONMENT JORDAN, ST. REGIS BORGIA RIVER,
Bitter Root Mountains, W. T., January 2, 1860.

SIR: I have the honor to present the folllowing report of my operations in the field during the months of September, October, November, and December, 1859, while engaged in running a line of levels over the military wagon road, from the Cœur d'Aléne mission to Cantonment Jordan. In obedience to your verbal instructions of September 14, I proceeded to the Cœur d'Aléne mission, and commenced the level survey of the road on the 17th of the same month.

The water level of the springs, at the western base of the Mission hill, was chosen as the commencement point of the line, as it is the lowest point in the vicinity, and is also but a few inches above the level of the water in the Cœur d'Aléne river at the mission.

The Cœur d'Aléne river, which, at the first crossing, one mile above the mission, has a width of eighty feet, a current of a mile and a half an hour, and a mean depth of two feet, attains just below the mission an average width of two hundred feet, and a depth of at least fifteen feet, with a current that is so slow as to be imperceptible. This character is preserved from the mission to the outlet of the river, in the Cœur d'Aléne lake, a distance of twenty-one miles in an air line, and twenty-seven by the windings of the river, for which distance the river, which here, in fact, is only an arm of the lake, is unquestionably navigable. and has but little, if any, fall.

Six hundred feet north of the commencement point is a level plain, which extends to the northward three-fourths of a mile to the base of a range of hills, which rise to a height of five hundred feet, and form the northern boundary of the mission valley, which last has a length of three miles. This plain is covered with a fine growth of grass, which affords an abundance of pasturage for the bands of horses and cattle belonging to the missionaries and Indians. In the spring and autumn, however, it is mostly wet and marshy. Its eastern end is bounded by a high projecting spur of basaltic rock, which extends thence to the river, a distance of eight-tenths of a mile, and is the only rock of that formation which has been seen along the line of the road, from the mission to Cantonment Jordan. The hill on which the mission stands, and along the base of which the military wagon road passes, is eighty-two feet high, and presents a singular appearance, rising conically-shaped out of a level plain, without being in any way connected with the mountain ranges on either side of the valley.

Upon its summit are the buildings of the mission, which consist of a large church and two houses for the dwellings of the priests and lay brothers, around which are scattered various tenements, lodges, &c., comprising the Indian village. At the northwest corner of the portico of the church building is placed bench mark No. 1; height above the commencement point eighty-eight and twenty-nine one hundredths feet. At the eastern base of the mission hill is a gully thirteen feet deep and seventy-five feet wide, which drains the hills to the north and east, but which is dry during the summer months. At station three is the western fence of the enclosure known as the mission field, which is used by the fathers as a farm, and extends to the east as far as the first crossing, and is bounded on the north by the basaltic spur before noticed, and on the south by the river, having an extent of nine tenths of a mile in length by two tenths in width.

The first crossing of the river is made just below the point where it leaves the spur, and being narrowed by a gravelly point, which becomes an island at high water, runs swift over a gravelly bed, with an average depth of two feet and a width at the point of crossing of eighty feet. Should this ford be deepened it is quite probable that the length of navigation on the river can be extended to near the Ten-Mile prairie.

The general character of the banks of the Cœur d'Alène river at its crossings is very favorable for the purposes of bridging, being of a gravelly formation and perpendicular to the water's edge, and also not subject to overflow. The bed of the river throughout is also gravelly. A very good point for bridging the first crossing is just below the ford. The banks are eleven feet above the water level, and would be connected by a bridge of two hundred feet in length. The distance from the starting point to the first crossing is one and two tenths miles.

From the first crossing to the Ten-Mile prairie the road passes over three saddles, known as the Four-Mile prairie saddle, height one hundred and ninety-three feet; the Seven-Mile prairie saddle, height two hundred and sixty-three feet; and the Ten-Mile prairie saddle, height three hundred and seven feet above the base line. These saddles are portions of the long spurs extending northwardly from the ridge of mountains to the south to the river, causing a large bend in the river, which otherwise runs in a remarkably direct line from its source in the mountains to the mission. Both the first and second saddles are not at the lowest points in their respective spurs.

The heavy growth of timber at these points effectually cuts off the view of the surrounding country, and the want of time did not admit of their further examination. There are points of the spurs which are at least fifty feet lower than these saddles, respectively.

Between the first crossing and the Four-Mile prairie the road runs over a prairie for three tenths of a mile, whence to the prairie it passes through a forrest composed of cedar, hemlock, and balsam timber, varying from four inches to three feet in diameter. The Four-Mile prairie, four miles from the mission, has an average width of two hundred and fifty feet, and is three quarters of a mile long, bordered on the north by the river and the south by a forest of timber, of the species before noted. The same character of growth covers the second saddle, and terminates at its eastern base.

A large tributary of the river comes in from the north, it is supposed, nearly opposite to the eastern end of the Four-Mile prairie. This tributary is represented by Father Josét, at the Cœur d'Alène mission, as being the main fork of the river. He states that Indians ascend it for some distance in their canoes. A glimpse of its valley has only as yet been obtained.

The Seven-Mile prairie is a stretch of nearly a mile and a half, sparsely covered with grass and open timber. Its soil is gravelly. This prairie extends some distance back into the country to the south, and is the mouth of a large ravine which runs southwardly into the mountains.

The many small gullies which run across it are evidently beds of streams in the spring when the snows melt, although in summer perfectly dry. The hills which form the eastern boundary of this prairie rise in a peculiar manner from its surface: instead of a curved line, as usual, joining the two plains of the side hill and the prairie, the place where they meet is a sharp and clearly defined angle.

This prairie is evidently the bed of a lake, which has filled up the valley of this mountain ravine by its gravelly debris.

The Ten-Mile prairie saddle intervenes between the eastern end of this prairie and the Ten-Mile or Mud prairie.

This saddle is the lowest point of its spur making down from the ridge on the south, and like the others is timbered from base to summit, and with a similar growth. The Ten-Mile prairie is about a mile in length, and from a quarter to three eighths in width. It is wet and miry in the spring from the melting snows, and in autumn from the rains; but at the time when passed over by our train was good and solid. A special survey is required from this to the mission, in order to decide upon a definite location for a railroad line; but the wagon road line is the shortest and most direct route either to the mission or lake. Distance from the mission to this prairie is nine miles; height of west end of prairie above the commencement point, eighty-three feet. From the Ten-Mile prairie to the second crossing the road passes through a forest of pine, hemlock, &c., and through a few small gravelly prairies covered with grass and brush. The timber is generally small, being about fifty feet in height and from six to twelve inches in diameter.

The river at the second crossing has a width of seventy feet and a mean depth of two feet. Its banks are generally sloping on the south and perpendicular and gravelly on the north; height above the river, six feet. One hundred feet below the crossing the river runs at the base of a spur, which last rises to a height of one hundred and fifty feet, and at an angle of inclination of 40°; out cropping limestone rock here makes its appearance. From station sixty-four to station sixty-eight the road runs at the base of a steep rocky ridge, (slope 30°.) The ground to the south towards the river in this distance is marshy and covered with a luxuriant growth of long meadow grass. Further examination may show a better location for the wagon road on the left bank. From station sixty-eight to station seventy-two the road is through a forest of cedar, hemlock, and pine, from two to three feet in diameter, after which it passes into a prairie with open timber, which extends to within two hundred feet of the third crossing. The water level of the third crossing is one hundred and eighty-seven feet above the base line, its width is sixty-six feet, and mean depth two feet. From this crossing eastwardly the valley becomes narrow, and the river exceedingly tortuous, flowing alternately at the base of the ridges that bound the valley on both sides, which rises up with a slope of from 35° to 75° to a height of from three hundred to six hundred feet, when they slope off more gently to the tops of the high mountain ridges. For the heights and distances of the crossing, and different points along the line from here to the summit, I would refer to the subjoined table of heights and distances.

From the third to the eleventh crossing, and from station one hundred and fifty-nine to the divide of the Cœur d'Aléne mountains, the timber is of a heavier growth and is more continuous than before. Cedars from three to six feet in diameter frequently occur. The pine becomes abundant, attaining a growth of from two to four feet in diameter, and from one hundred and fifty to two hundred feet high. The hills and spurs of the mountain ridges are also covered with pine, hemlock, and fir, which decrease in size in proportion to the elevation, until at the top of the high ridges they are mere dwarfs, and the tops of the highest peaks are entirely bald. Many of these peaks bordering the valley have a height of from five to seven thousand feet above the level of the sea, the height of the range generally being from fifteen hundred to three thousand feet above the level of the valley. A series of small prairies, connected by strips of small pine timber, begin near the eleventh crossing and continue as far as station one hundred and fifty-nine, a distance of four and a half miles, and only interrupted by two belts of timber, which together do not exceed a mile and a half in length.

At the seventeenth crossing is probably the confluence of the north and south forks of the river. The south fork is again crossed just above its junction with the other branch; height, six hundred and twenty-five feet; distance from the mission, twenty-four and five-tenths miles.

The first crossing of the north fork is one and one-tenth mile further to the eastward; between this and the second crossing three small tributaries come in from the north, the valley of the stream becomes very narrow and the ridges close up, forming a deep and narrow gorge, which at its mouth has a width of two hundred feet; this continues up to the ninth crossing, whence to the twenty-seventh, a distance of two and seven-tenths miles, the river runs between the spurs, which come down close, having only the width of the stream between them, with a narrow margin for the location of the military wagon road. The character of the road as it runs over the small spurs and plateau is indicated by the profile. The southern side of this ravine presents an almost unbroken wall, which slopes up from 30° to 60°, with ledges of rock outcropping in many places. The northern side, which is also steep, is intersected with four deep and narrow ravines, which extend to the summit of the mountain range, a distance of about two miles.

The last or most eastern of these ravines, called "Johnson's Cut-off," will afford good grazing for emigrants and others passing over the line, grass being found in its bottom about a mile above its mouth, and also on the hills on both sides.

From the twenty-seventh crossing the road rises up to a plateau and passes over the Long Prairie Saddle to avoid the Long Prairie, which is a marshy meadow about one hundred and fifteen acres in area, one-third of which is covered with grass, and the remainder with clumps of bushes and strips of small timber; the prairie is wet in early spring.

The Long Prairie Saddle is twelve hundred and nineteen feet above the base line, and the distance from the mission is thirty-one and three-quarter miles After descending from this saddle to station four hundred and six, the road is located upon the foot slope of the ridges, which have a plateau-like formation, and rises at an average rate of one hundred and eighteen and a half feet to the mile, in the direction of the road, until a summit is reached at station four hundred and forty-eight; thence it descends to the river bottom and reaches the foot of the divide of the Cœur d'Aléne or Bitter Root mountains at the twenty-eighth crossing of the northern fork of the river; distance from the mission thirty-five miles and thirty-eight hundredths: height, fourteen hundred and fifty-two feet, or an average fall of forty-one and four hundredths feet per mile. The average width of the river is forty-four feet.

The highest water mark seen was only three feet above its usual level. The average rise of the Cœur d'Aléne river for the first ten miles is ten feet per mile; for the next fifteen miles, thirty-five feet per mile, and for the remaining ten and thirty-eight hundredths miles, is seventy-nine and seventy-six hundredths feet per mile.

The summit of the divide of the Cœur d'Aléne or Bitter Root mountains at Sohon's Pass is four thousand nine hundred and thirty-two feet above the level of the sea, two thousand eight hundred and four and ninety-two hundredths feet above the base line, and thirteen hundred and fifty-three feet above the last crossing of the north fork of the Cœur d'Aléne river; which last height is attained in an air line distance of one and five hundredths miles.

Its summit is gained by the military wagon road, by means of two long bends or curves which are graded on and into the side of the mountain, the distance by this road being one and seventy-two hundredths miles.

The rock lies generally some four feet under the surface of the ground; but at the place known as the "Point of Rocks" blue limestone rock outcrops.

From this place the road up to the summit runs on the natural surface of the ground. The descent of three hundred and ninety-two feet from the summit, to the first crossing of the St. Regis Borgia river, is made in seven-tenths of a mile, in nearly a direct line, over the natural surface of the mountain.

The divide over these mountains has had as careful an examination as the time of our disposal would allow, with a view to obtain, as much correct information as possible for determining the best location and probable length of a tunnel for the passage of a railroad line. There are two passes to the north and east of Sohon's Pass; the first, two miles to the north, is higher than Sohon's Pass and also wider from base to base; the second is some ten miles distant, at the north fork of the Cœur d'Aléne. These require a special examination of their approaches, to enable us to say anything definite in regard to them. At least a month should be spent in this region, so interesting to the topographer and the artist, to obtain at least an approximately correct sketch of the outlines of these passes and their approaches.

Two miles to the south of Sohon's Pass the ridge of the mountains dividing the waters of the St. Regis Borgia from one of the small tributaries of the north fork of the Cœur d'Aléne, which empties itself into that stream a mile or so above Long Prairie, becomes very narrow, sloping on the east at an angle of forty-five degrees, and to the west is nearly perpendicular for fifteen hundred feet. A tunnel could be made at this point of not more than one thousand feet in length, but its approach would involve such steep grades, and heavy embankments across deep ravines, as to be impracticable. The eastern base of the mountain in the valley of the St. Regis Borgia at this place, as determined by an observation with the aneroid barometer, is higher than the summit of Sohon's Pass; it is therefore evident that to pierce the divide of these mountains, either Sohon's Pass must be taken as the tunnelling point or a more favorable line be found through the mountain ranges to the north and east.

The St. Regis Borgia river has its rise in a small bowl-like lake 500 feet in diameter, carved by nature out of the steep rocky walls of one of the spurs of Stevens's Peak. After leaving this spring it tumbles down 300 feet in a quarter of a mile, through a narrow, rocky channel; after which it flows through a valley a tenth of a mile in average width, to the first crossing. The distance from the source to this point is about two miles, and the entire fall is 1,250 feet.

From the first to the second crossing, a distance of two and a half miles, the road passes over the foot slopes of the ridges on the right bank of the river, which have a general transverse slope of one in ten. The descent from the first to the second crossing is 549 feet.

From the third to the sixth crossing, a distance of five-tenths of a mile, the valley is about 100 feet wide, having only a narrow strip of ground between the river and the foot of the spurs. The rock is seen outcropping in many places, having a slope towards the river of from 40° to 70°.

From the sixth to the seventh crossing, one and fifteen hundredths miles, the road passes for 800 feet at the base of the ridge on the left bank; whence, for the remaining distance, it passes over a plateau, from 60 to 150 feet wide, and four feet above the river bottom. Between the seventh and eighth crossing is a small prairie 500 feet long and 250 feet wide, called the "Five-Mile Prairie." The distance from the summit to the eighth crossing is five and sixty-five hundredths miles.

From the eighth to the thirty-second crossing, eight and three tenths miles, the valley is generally narrow, being from 100 to 200 feet wide. Wherever a prairie occurs the ridges and slopes recede, and the valley becomes from 200 to 600 feet in width. The principal prairies in this distance lie between the eight and ninth, the ninth and tenth, and the thirty and thirty-first crossing. The valley between the last-mentioned crossings has a width of from 500 to 1,000 feet.

The thirty-second crossing is at the entrance to the cañon of the St. Regis Borgia, which extends to the thirty-eighth crossing, a distance of one and a half mile. This cañon, so called, is merely a narrow ravine, or gorge, through which the river flows. The spurs which close up the valley have a slope of from 35° to 40°, and are covered with a growth of small timber; outcropping ledges of rock were only observed opposite to station 790. The road is located on small plateaus at the base of the spurs for most of the distance. From the forty to the forty-first crossing the road passes over rolling prairie ground with belts of open timber. Here is the mouth of a large ravine which comes in from the range of mountains on the north, the valley becomes wider, and the river flows near the hills at the southern side of the valley. The stretches of prairie between the forty-second, forty-third, forty-fourth, and forty-fifth crossings are also the debouches of similar ravines. On these prairies will be found an abundant supply of grass during spring and summer, although at the time of the survey, November 20 to 25, all these prairies were covered with snow to a depth of one and four tenths feet.

The forty-first and forty-second crossing, and also the forty-third and forty-fourth, are made in order to avoid two rocky spurs which run down to the water's edge at an angle of 35°. Here the blue limestone outcrops and presents a regular stratified appearance; the thickness of the strata is from one to four feet, and dips from east to west at an angle of about 45°. The strata forming the spur between the forty-third and forty-fourth crossing has a dip of 60°, and the rock is of a whiter hue, more resembling marble. The forty-fifth and the forty-sixth crossings are made to avoid a swampy flat, occasioned by a stream coming from the north, which sinks into the ground instead of emptying directly into the river. From the forty-sixth, or last, crossing to Cantonment Jordan, a distance of one and ninety-six hundredths miles, we pass over a series of plateaus and rolling ground, with prairies and belts of small timber.

The character of the valley of the St. Regis Borgia is quite different from that of the Cœur d'Aléne, rising in steps or plateaus of four or five feet each, instead of being a narrow bottom three or four feet above the water level. The timber, both in the valley and on the sides of the spurs and mountains, is more open and smaller than the same character of growth on the western slope of the mountains. The pine is generally about fifty feet in height and from one to six inches in diameter, although occasionally trees are found much larger; the hemlock and fir predominating, while the cottonwood is seen lining the immediate banks of the river. Wherever the prairies already spoken of appear the pines are smaller and evidently of a later growth, and the other timber becomes more open and scattering. The river itself has a more rapid descent than the Cœur d'Aléne, as is shown by the following table, the average width being about thirty-eight feet:

	Distance in miles.	Descent in feet.	Average descent per mile.
From 1st to 2d crossing	2.50	549	219.60
From 2d to 9th crossing	3.57	312	87.40
From 9th to 26th crossing	4.48	282	62.94
From 26th to 46th crossing	9.05	354	39.12
Total	19.60	1,497	

The descent of the military wagon road from the forty-sixth crossing of the St. Regis Borgia to Cantonment Jordan, a distance of one and ninety-six hundredths miles, is forty-five feet. The height of Cantonment Jordan above the the base line at the mission is 871 feet, and its distance from the mission is fifty-nine and one-third miles; and from old Fort Walla-Walla, the initial point proper of the road, 288 miles; height above the sea, 2,998 feet.

I am, sir, respectfully, your obedient servant,

W. W. JOHNSON, *Civil Engineer.*

Lieutenant JOHN MULLAN,
United States Army, in charge of Fort Walla-Walla and
Fort Benton Military Wagon Road Expedition.

Table of heights and distances on the Fort Walla-Walla and Fort Benton military wagon road from the Cœur d'Aléne mission to Cantonment Jordan, as determined by W. W. Johnson, civil engineer.

Place.	Height in feet above base.	Distance from the Cœur d'Aléne mission.	Place.	Height in feet above base.	Distance from the Cœur d'Aléne mission.
Mission Hill	82	....	28th crossing North Fork	1,459	35.35
1st crossing Cœur d'Aléne river	10	1.13	Point of Rocks	2,669	36.80
4-Mile Prairie Saddle	119	3.25	Summit of Sohon's Pass	2,804	37.10
4-Mile Prairie	40	4.00	1st crossing St. Regis Borgia river	2,413	37.80
7-Mile Prairie Saddle	263	5.60	Small stream	2,136	38.85
7-Mile Prairie	138	6.50	2d crossing St. Regis Borgia river	1,861	40.30
10-Mile Prairie Saddle	307	7.65	3d do do	1,833	40.55
10-Mile Prairie	83	9.00	4th do do	1,822	40.65
2d crossing Cœur d'Aléne river	112	10.65	5th do do	1,805	40.75
Station 72	153	11.90	6th do do	1,799	40.80
3d crossing Cœur d'Aléne river	188	13.27	Small stream	1,783	41.00
4th do do	193	13.45	7th crossing St. Regis Borgia river	1,670	42.00
5th do do	199	13.65	8th do do	1,611	42.75
6th do do	206	14.15	9th do do	1,553	43.90
7th do do	212	14.30	10th do do	1,538	44.30
8th do do	217	14.55	11th do do	1,489	44.80
9th do do	224	14.80	12th do do	1,470	44.82
10th do do	242	15.52	13th do do	1,446	45.20
11th do do	257	16.25	14th do do	1,435	45.65
12th do do	293	17.38	15th do do	1,420	45.85
13th do do	311	18.00	16th do do	1,411	46.05
Station 159	438	20.80	17th do do	1,397	46.25
14th crossing Cœur d'Aléne river	488	22.10	18th crossing 1st stream	1,390	46.60
15th do do	521	22.93	18th do 2d stream	1,387	46.65
16th do do	566	23.90	18th do 3d stream	1,389	46.70
17th crossing & tributaries, station 204	524	24.20	19th crossing St. Regis Borgia river	1,380	46.85
South Fork	606	24.50	20th do do	1,372	46.90
1st crossing North Fork	625	25.05	21st do do	1,363	47.10
Small stream	637	25.25	22d do do	1,354	47.20
2d crossing North Fork	645	25.50	23d do do	1,345	47.30
3d do	653	25.65	24th do do	1,330	47.45
4th do	675	26.00	25th do do	1,298	47.90
5th do	707	26.53	26th do do	1,269	48.40
6th do	717	26.75	27th do do	1,244	48.50
7th do	720	26.80	Small creek	1,248	48.90
8th do	756	27.37	28th crossing St. Regis Borgia river	1,232	49.10
9th do	826	28.40	29th do do	1,215	49.47
10th do	836	28.55	30th do do	1,907	49.65
11th do	854	28.75	31st do do	1,174	50.45
12th do	862	28.85	32d do do	1,152	51.10
13th do	868	28.97	33d do do	1,148	51.15
14th do	871	29.03	34th do do	1,136	51.30
15th do	892	29.25	35th do do	1,132	51.40
16th do	907	29.50	36th do do	1,125	51.80
17th do	915	29.60	37th do do	1,100	52.25
18th do	936	29.85	38th do do	1,093	52.35
19th do	942	30.05	39th do do	1,080	52.85
20th do	936	30.20	40th do do	1,074	53.05
21st do	968	30.32	Stream	1,054	54.30
22d do	1,007	30.55	Small creek	1,012	55.10
23d do	1,010	30.60	do	1,011	55.15
24th do	1,023	30.75	41st crossing St. Regis Borgia river	978	55.30
25th do	1,028	30.80	42d do do	975	55.40
26th do	1,042	31.02	43d do do	945	56.25
27th do	1,045	31.05	44th do d,	940	56.50
Long Prairie Saddle	1,219	31.75	45th do do	922	57.20
Station 406	1,167	32.35	46th do do.	916	57.40
Station 448	1,507	35.15	Cantonment Jordan	881	59.25

SIR: In obedience to your orders of March 27th, I started on April 4th from the wagon road crossing on the Bitter Root river to make a survey of part of the Bitter Root river, Clark's Fork, and Flathead rivers. I took with me one of the flat-bottomed boats built at the ferry, about twelve feet long, two men, and rations for thirty days. The weather at first was unfavorable, and delayed us several days. I was successful in getting the boat over all the rapids in the Bitter Root river and went down the Clark's Fork about ten miles, and thus ascended the Flathead to the mouth of Plum creek, on which the Pend d'Oreille mission is situated. I visited the mission, where I was most hospitably received by the reverend fathers Louis and Minetrey, and connected it with my survey, and finally returned to the wagon road crossing on the 21st of April, having to cordelle my boat all the way up the Bitter Root and haul it unloaded over the two worst rapids.

From the crossing to the mouth of the Bitter Root is a distance of twenty-three miles. It is about 500 feet wide at the ferry, but the breadth is diminished below as the mountains press closer; on the river, at several rocky points, it is not more than half that width. Its general course for seventeen miles is to the northeast; it then turns north to its junction with the Flathead river. It is exceedingly crooked and tortuous, has a very strong current and many rapids, of which four are very bad ones, the channel being obstructed by large rocks. On both sides are rocky, rugged mountains, from 1,600 to 2,000 feet high, bordering directly on the river, except in the bends, which are generally occupied by plateaus twenty to eighty feet high, there sometimes being in the same bend two or three rising one above the other; they are not usually of great extent, and, like the mountains, are covered with pine timber. It has no tributaries of any consequence, there being only three small creeks flowing into it, and but one island of any size, not far below the crossing

On reaching the junction of the Bitter Root and Flathead, I immediately continued my survey down the Clark's Fork as far as Horse Plain, on the right bank. Opposite the mouth of the Flathead river, on the right bank, there is a rocky, precipitous mountain coming close to the river, and impassable for man or animals. This ends, however, about half a mile down the fork, and a flat succeeds, covered with grass and scattering pines, which continues for some five miles, after which there are rolling grassy hills and points of rock to the Horse Plain. This is an extensive flat, on a high plateau, more than a mile wide and very long, and covered with fine grass. On the opposite side is a similar plain, but not so large, apparently. The left bank of Clark's Fork is rocky and mountainous for nearly the whole distance to the last-mentioned plain, the mountains being higher and more rugged than those on the right bank.

At the junction of the Bitter Root and Flathead there is likewise a grass plain which extends up the latter river some two miles, when the mountains close in on both sides. At about seven miles and a half from its mouth there is a bad rapid extending across the river; this was the only one on it as far as my survey extended. About ten miles above its mouth the rugged and rocky mountains on either side end; the hills become gentler in slope and of much less altitude, and are either bare, or partially so, of timber, whilst many of them are covered with grass to the summits, particularly on the right bank. Along the river, also, are many grass flats, or plateaus, from twenty to forty feet high, some of which, as those opposite and below the mouth of the Jocko river, are very large.

This river is wider than the Bitter Root, and flows in a very straight course, with only (as far as I examined it) two large bends. There is a group of large islands about 20 miles from its mouth, and several smaller ones at different points. Its general direction, as far as the mouth of the Jocko river, is southeast; it then makes a sharp bend and flows in a westerly course to its mouth. The current is very moderate for about 20 miles, there being no difficulty in rowing the boat for that distance; and could the rocks at the rapids before mentioned be removed, it would be navigable by small steamboats as far as I explored it, say, 30 miles.

Its principal tributaries, the Jocko river and Plum creek, are on the left bank; there is another above, on which is a Hudson Bay post. which I did not see.

Between Plum creek and the Jocko there is a low range of bare, grassy hills. On the right bank of the creek, however, the whole country is a high, rolling plateau, covered with grass, on which were numbers of Indian cattle and horses, which appeared to be in excellent order. The creek heads in a high, rugged range of mountains, stretching to the northeast, and on the plain at its foot, 10 miles from the river, is located the Pend d'Oreille, or St. Ignatius mission. Here were enclosed fields and gardens, cultivated by the Indians, under the direction of the Fathers. They have a saw and grist mill, several log houses and a church, and are building a larger one, which, however, progresses slowly, for want of funds. Scattered around were the usual conical wigwams of the Indians, the greater portion of the tribe being settled here. Most of the men, however, were absent hunting, and but few besides old men, women, and children, were left. Everything around gave evidence of the unwearied energy and industry of the worthy missionaries for the benefit of the savages amongst whom their lot was cast.

After remaining here a day, I returned to the boat and commenced the descent of the river. I would remark here that all these waters abound in fish, and also great numbers of ducks and geese. From the mission a trail descends the left bank of the creek, crossing the river about a mile below the mouth of the creek, where there is a ford in low water, and continues down the right bank of the river for about 18 miles, when it turns up a ravine and passes over to the Clark's Fork by the Camass prairie. There is another trail along the left bank of the river to its mouth.

On the Bitter Root river there is no trail on the right bank, and the one on the left bank leaves the river about six and a half miles from the wagon-road ferry and crosses the mountains, coming to the Clark's Fork at the Horse Plain.

As regards the practicability of making either wagon road or railroad up the Clark's Fork and Flathead rivers, I would remark that the right is the most favorable. A wagon road, and perhaps the railroad too, (I cannot speak positively, not having seen that portion of the route,) would have to take the line of the Camass prairie trail, as there would be miles of rock cutting by the line of the river. From the point where the trail strikes the river again, there is no extraordinary difficulty and little rock cutting. To take either of them up the Bitter Root, the left bank would be the most favorable, as having the largest number of plateaus, but even then would be attended with immense expense and labor, as there would be at least seven or eight miles of rock to cut through.

The rock formation seems to be trap, and its varieties dipping to the south, generally at an angle of 45 degrees. There has been an upheaval and disturbance of the whole of this region. Neither fossils nor evidences of metallic minerals were found, though both were looked for when opportunities presented.

The distances on this survey were measured by my paces, carefully compared from time to time with measurements by a tape line.

In conclusion, I would beg leave to mention in terms of praise the two men who accompanied me, Isaac Grier and Dan Smith, privates, 3d artillery, for their good conduct throughout the trip, but particularly when dragging the boat up the Bitter Root river, where they were in the water nearly from morning till night.

I am, sir, with much respect, &c.,

W. W. DE LACY, *Civil Engineer*

Fort Walla-Walla and Fort Benton Wagon Road Expedition.

Lieut. JOHN MULLAN, U. S. A.,

Commanding Military Wagon Road Expedition

From Fort Walla-Walla to Fort Benton.

CANTONMENT JORDAN, BITTER ROOT MOUNTAINS,
Washington Territory, January 25, 1860.

SIR: I have the honor to state that the meteorological observations made in connexion with the construction of the military road from Fort Walla-Walla to Fort Benton furnish the material for a profile of the road.

The instruments used in the determination of heights were, Green's cistern barometer No. 1,273, and aneroid No. 18,314.

The reductions were made with Guyot's meteorological and physical tables. The barometer reading at the level of the sea, and reduced to 32° (F.) for latitudes 46° and 47°, was taken at 30,000 in. The absolute heights, or heights above the sea level of the stations at New Fort Walla-Walla, Fort Taylor, In-Chats-Khan, Cœur d'Aléne mission and Sohon's Pass, were determined by a great number of observations, to which the necessary corrections were applied. The intermediate points were computed from observations with the aneroid, and the reductions made by the application of table sixth of Guyot, as given in the compilation of forms prepared for the Smithsonian Institution, and published in 1858. Indeed, the general principles laid down by Guyot in his table (No. 2) for computing differences of elevation from barometical observations, and the formula there given, have been generally followed.

The heights as given from Fort Walla-Walla to Cœur d'Aléne mission being compiled without corresponding observations, may be doubtful to the amount of the variation during the time of travelling from one camp to the next, generally from 5 to 7 hours. The correction for annual variation was deduced from the mean of the observations made at Cantonment Stevens and Fort Benton in 1853 and 1854.

From the mission to Sohon's Pass corresponding observations have been made use of, and at some places between these points the road having been passsed over several times, the mean of two or three determinations was taken.

The greatest error, assuming the level profile correct, is 48 feet, and the probable error for a single observation is ± 7 feet. The observations from which the annual variation was deduced are given in Pacific Railroad Report, volume 1st, pages 594 and 8. Their interpolated mean was found to answer for the purposes of reduction and amounted to 59 feet between Cœur d'Aléne mission and Sohon's Pass.

The positions of the stations between camps were determined by a watch, the whole distances between the camps being measured by an odometer. From the Cœur d'Aléne mission to Cantonment Jordan, between which points a spirit-level line was run, the aneroid readings were generally taken at level stations, in order to compare the profile made from the aneroid with that made from the levelling instrument.

The table of heights deduced along the line, with the respective number of observations from which they were computed, is herewith appended.

I am, &c.,

JOHN WIESNER,
Meteorologist and Astronomer of Military Road Expedition.

Lieutenant JOHN MULLAN,
United States Army, in charge of
Military Wagon Road from Fort Walla-Walla to Fort Benton.

Table of heights.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Heights above sea level.
1859.		*Miles.*		*Feet.*
May 21, June 22	New Fort Walla-Walla	0.00	240	915
June 23	Summit of divide between Mill creek and Dry creek	6 50	2	954
June 23 and 24	Camp on Dry creek	9.30	9	889
June 24	Summit of divide between Dry creek and Touchet	19.30	3	1,306
June 24 and 25	Camp at the crossing of the Touchet	20.70	17	1,145
June 25	Reed Creek valley	26.38	1	1,264
Do.	Point intermediate	27.01	1	1,434
Do.	Reed creek, 1st crossing	31.58	2	1,500
Do.	Reed creek, 3d crossing	33.48	3	1,770
June 26 and 27	Reed creek, camp	34.90	12	1,919
June 28 and 29	Summit of divide between Touchet and Toukanon	37.15	9	2,206
Do.	Crossing of the Toukanon	47.30	5	651
June 29, July 3	Camp at Fort Taylor, on Snake river, 9¼ feet above high water	49.80	60	579
July 3 and 4	Snake river bank, opposite Fort Taylor	49.97	9	695
July 4	Point intermediate	52.06	3	1,051
Do.	do.	53.11	1	1,121
Do.	do.	53.53	1	1,061
Do.	do.	53 99	1	1,225
Do.	do.	54.37	1	1,230
Do.	do.	54.76	1	1,275
Do.	do.	55.63	1	1,269
Do.	do.	56.09	1	1,411
Do.	do.	56.86	1	1,157
Do.	do.	57.91	1	1,605
Do.	do.	58 26	1	1,600
Do.	do.	58.69	1	1,777
Do.	do.	59.24	1	1,706
Do.	do.	59.41	1	1,721
Do.	do.	59.58	1	1,504
Do.	do.	59.86	1	1,549
Do.	do.	60.39	1	1,525
Do.	do.	61.33	1	1,578
Do.	do	61.82	1	1,646
Do.	do.	62.80	1	1,500
Do.	do.	63.85	1	1,466
July 4 and 5	1st camp on the Palouse	64.90	9	1,325
July 5	Point intermediate	65.69	1	1,300
Do.	1st crossing of the Palouse	69.30	1	1,373
Do.	Summit of divide	72.10	1	1,511
July 6	2d camp on the Palouse	73.00	5	1,402
Do.	2d crossing of the Palouse	73.10	1	1,438
Do.	Point intermediate	74.10	1	1,446
July 7, 9	3d camp on the Palouse	75.30	31	1,463
July 9	3d crossing of the Palouse	75.35	1	1,451
Do.	Point intermediate	75.97	1	1,469
Do.	4th crossing of the Palouse	76.59	1	1,463
Do.	Point intermediate	77 83	1	1,583
Do.	do.	78.45	1	1,660
Do.	do.	79.07	1	1,560
Do.	do.	80.92	1	1,473
Do.	do.	81.85	1	1,468
July 9, 11	4th camp on the Palouse	83.60	11	1.500
July 11	Point intermediate	85.92	1	1,678
Do.	do.	86.56	1	1,700
Do.	do.	89.95	1	1,709
Do.	do.	91.73	1	1,793
Do.	do.	94.26	1	1,925
Do.	do.	95.53	1	1,905
Do.	Crossing of the O-ray-tay-oose	96.75	1	1,847
July 11, 12	Camp on the O-ray-tay-oose	96 80	4	1,800
July 12	Point intermediate	97.64	1	1,806
Do.	do.	98.48	1	1,974
Do.	do.	101.82	1	1,906
Do.	do.	105.16	1	2,190
Do.	do.	106.84	1	2.250
Do.	do.	108.52	1	2,306
July 12, 13	Camp on the Tcho-tcho-oo-sep	112.70	6	2,172
July 13	Point intermediate	114.97	1	2,316
Do.	do.	115.54	1	2,305
Do.	do.	116.11	1	2,270
Do.	do.	118.38	1	2,364
Do.	do.	118.76	1	2,358

Table of heights—Continued.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Height above sea level.
1859.		*Miles.*		*Feet.*
July 13	Point intermediate	120.66	1	2,413
Do.	do.	121.23	1	2,423
July 13, 14	Camp on the Sil-say-pow-vet-sin	121.80	5	2,331
July 14	Point intermediate	125.93	1	2,686
Do.	do.	127.99	1	2,536
Do.	do.	131.08	1	2,704
Do.	do.	135.21	1	2,511
July 14, 15	Camp on the Lah-too	138.30	6	2,460
July 15	Crossing of the Lah-too	138.35	1	2,448
Do.	Point intermediate	138 34	1	2,758
Do.	do.	139.26	1	2,608
Do.	do.	139.90	1	2,601
Do.	do.	143.29	1	2,823
Do.	do.	144.74	1	2,669
Do.	do.	145.06	1	2,717
Do.	do.	145 16	1	2,687
Do.	do.	145.54	1	2,744
Do.	do.	146.02	1	2,601
July 15, 16	Camp on the Lo-choolts	149.90	6	2,688
July 16	Point intermediate	151.23	1	2,713
Do.	do.	152.56	1	2,795
Do.	do.	153 45	1	2,739
Do.	do.	154 56	1	2,795
July 16 to 23	Camp on the In-chats-khan	157.90	66	2,765
July 23	Point intermediate	160.40	4	2,905
Do.	do.	163.25	4	2,955
Do.	Outlet of Pown lake, at bridge	164.00	4	2,205
July 23, 24	1st camp on the St. Joseph's river	165.00	11	2,209
July 24 to 31	2d camp on the St. Joseph's river	169.00	51	2,208
August 5	Old Cœur d'Aléne mission	169.70	1	2,415
Do.	1st camp on Cœur d'Aléne river	179.60	1	2,206
Do.	Cœur d'Aléne mission, slackwater	198.39	2	2,198
August 2 to Sept. 14.	Cœur d'Aléne mission, observatory	198.47	416	2,280
September 14	Cœur d'Aléne mission, field	198.67	2	2,228
Do.	Cœur d'Aléne river, 1st crossing above mission	199.59	2	2,226
September 14, 15	Point intermediate	200.12	25	2,232
September 15	do.	200.26	1	2,235
Do.	do.	200.40	1	2,247
Do.	do.	200.51	1	2,232
Do.	do.	200.64	1	2,237
Do.	do.	200.89	1	2,244
Do.	do.	200.99	1	2,276
Do.	do.	201.22	1	2,293
Do.	do.	201.45	1	2,371
Do.	do.	201.65	1	2,394
Do.	do.	202.00	2	2,232
Do.	do.	202 13	2	2,229
Do.	do.	202.32	2	2,2[illegible]6
Do.	do.	202.64	2	2,239
September 15 to 19	do.	203.02	34	2,250
September 19	do.	203.23	1	2,250
Do.	do.	203.39	1	2,280
Do.	do.	203.62	1	2,347
Do.	do.	203.73	1	2,359
Do.	do.	203.82	1	2,403
Do.	do.	203.95	1	2,468
Do.	do.	204.00	1	2,436
Do.	do.	204.11	1	2,455
Do.	do.	204.27	1	2,364
Do.	do.	204.34	1	2,377
Do.	do.	204.60	1	2,310
Do.	do.	204.67	1	2,306
Do.	do.	204.77	1	2,310
Do.	do.	205 29	1	2,306
September 19, 20	do.	205.55	11	2,296
September 20	do.	205 62	3	2,356
Do.	do.	205.85	3	2,462
Do.	do.	206.02	3	2,506
Do.	do.	206.18	3	2,413
Do.	do.	206.54	3	2,332
Do.	do.	207.04	3	2,281
September 20 to 23	Depot Camp, on Ten-Mile prairie	207.81	33	2,286
September 23	Cœur d'Aléne river, 2d crossing	209.00	3	2,307

Table of heights—Continued.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Heights above sea level.
1859.		*Miles.*		*Feet.*
September 23, 24	Point intermediate	209.19	13	[illegible]
September 24	do.	209.31	3	[illegible]
Do.	do.	209.56	3	[illegible]
Do.	do.	209.61	3	[illegible]
Do.	do.	209.71	3	[illegible]
Do.	do.	209.78	3	[illegible]
Do.	do.	209.84	3	[illegible]
Do.	do.	210.10	1	[illegible]
Do.	do.	210.18	1	[illegible]
Do.	do.	210.37	1	[illegible]
Do.	do.	210.46	1	[illegible]
Do.	do.	210.55	1	[illegible]
Do.	do.	210.72	1	[illegible]
September 24, 25	do.	211.38	17	[illegible]
September 26	do.	211.56	2	[illegible]
Do.	Cœur d'Alêne river, 3d crossing	211.69	2	[illegible]
Do.	Point intermediate	211.77	2	[illegible]
Do.	Cœur d'Alêne river, 4th crossing	211.88	2	[illegible]
Do.	Point intermediate	211.98	2	[illegible]
Do.	Cœur d'Alêne river, 5th crossing	212.02	2	[illegible]
Do.	do. 6th do.	212.47	2	[illegible]
Do.	do. 7th do.	212.69	2	2,411
Do.	do. 8th do.	212.90	2	2,418
Do.	do. 9th do.	213.17	2	[illegible]
Do.	Point intermediate	213.73	2	[illegible]
Do.	Cœur d'Alêne river, 10th crossing	213.91	2	[illegible]
Do.	Point intermediate	214.05	2	[illegible]
Do.	do.	214.19	2	[illegible]
September 26 to 30	do.	214.29	30	[illegible]
September 30	do.	214.41	1	[illegible]
Do.	do.	214.53	1	[illegible]
Do.	Cœur d'Alêne river, 11th crossing	214.65	1	[illegible]
Do.	Creek	215.03	1	2,475
Do.	Creek	215.32	1	[illegible]
Do.	Point intermediate on prairie	215.51	1	[illegible]
Do.	Cœur d'Alêne river, 12th crossing	215.74	1	[illegible]
Do.	do. 13th do. 1st branch	216 39	1	[illegible]
Do.	do. 13th do. 2d branch	216.45	1	[illegible]
Do.	Point intermediate	217.36	1	[illegible]
Do.	do.	217.45	1	[illegible]
Do.	do.	218.50	1	[illegible]
Do.	do.	218.64	2	[illegible]
Sept. 30 to Oct. 2	do.	219.23	25	[illegible]
October 2	Cœur d'Alêne river, 14th crossing	220.49	3	[illegible]
Do.	do. 15th do	221.29	3	[illegible]
Do.	do. 16th do	222.30	3	[illegible]
Do.	do. 17th do. 1st part	222.51	1	[illegible]
Do.	do. 17th do 2d part	222.65	1	[illegible]
Do.	do. south fork	222.89	1	[illegible]
Do.	do. north fork, 1st crossing	223.48	1	[illegible]
Do.	Point intermediate	223 62	1	[illegible]
Do.	Cœur d'Alêne river, north fork, 2d crossing	223.88	2	[illegible]
Do.	do. do. 3d do.	224.03	2	[illegible]
Do.	do do. 4th do.	224.30	2	[illegible]
Do.	Point intermediate	224.58	2	[illegible]
Do.	do.	224.73	2	[illegible]
Do.	do.	224.80	2	[illegible]
Do.	Cœur d'Alêne river, north fork, 5th crossing	224.91	2	[illegible]
Do.	do. do. 6th do	225.14	2	[illegible]
Do.	do. do 7th do	225.20	2	[illegible]
October 2 to 4	Point intermediate	225.50	2	[illegible]
Do.	Cœur d'Alêne river, north fork, 8th crossing	225.76	2	[illegible]
Do.	do. do. 9th do.	226.74	2	[illegible]
Do.	do. do. 10th do.	226.92	2	[illegible]
Do.	do. do 11th do.	227.13	2	[illegible]
Do.	do. do. 12th do.	227.26	2	[illegible]
Do.	do. do. 13th do.	227.37	2	[illegible]
Do.	do. do. 14th do.	227.40	2	[illegible]
Do.	do. do. 15th do.	227.62	2	[illegible]
Do.	do. do. 16th do.	227.89	2	[illegible]
Do.	Point intermediate	227.96	2	[illegible]
Do.	Cœur d'Alêne river, north fork, 17th crossing	228.00	2	[illegible]
Do.	do. do. 18th do.	228.26	2	[illegible]
Do.	do. do. 19th do.	228.42	2	[illegible]

Table of heights—Continued.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Heights above sea level.
1859.		*Miles.*		*Feet.*
October 2 to 4	Cœur d'Aléne river, north fork, 20th crossing	228.69	2	3,148
Do.	do. do. 21st do.	228.73	2	3,168
Do.	Point intermediate	[illegible].85	2	3,223
Do.	Cœur d'Aléne river, north fork, 22d crossing	228.91	2	3,197
Do.	do. do. 23d do.	229.00	2	3,209
Do.	do. do. 24th do.	229.13	2	3,218
Do.	do. do. 25th do.	229.17	2	3,223
Do.	do. do. 26th do.	229.40	2	3,241
Do.	do. do. 27th do.	229.46	2	3,243
Do.	Point intermediate	229.53	2	3,273
Do.	do.	230.15	2	3,415
Do.	do.	230.27	2	3,373
Do.	do.	231.07	2	3,427
Do.	do.	231.16	2	3,385
Do.	do.	231.64	2	3,462
Do.	do.	231.74	2	3,433
Do.	do.	231.99	2	3,460
Do.	do.	232.47	2	3,512
Do.	do.	232.92	2	3,577
Do.	do.	233.55	2	3,697
October 14 to 21	do.	233.63	20	3,643
October 21	Cœur d'Aléne river, north fork, 28th or last crossing	233.75	3	3,648
Do.	Creek.	233.84	1	3,687
Do.	Point intermediate	233.99	1	3,849
Do.	do.	234.05	1	3,939
Do.	do.	234.10	1	3,989
Do.	do.	234.27	1	4,186
Do.	do.	234.54	1	4,320
Do.	do.	234.78	1	4,563
Do.	do.	234.92	1	4,691
Do.	do.	235.03	1	4,791
Do.	do.	235.09	1	4,846
Do.	do.	235.18	1	4,875
October 6, Nov. 1	"Sohon's Pass" observatory	235.51	225	5,006
October 21	Point intermediate	235.68	1	4,906
Do.	do.	235.81	1	4,827
Do.	do.	235.89	1	4,758
Do.	do.	235.94	1	4,729
Do.	do.	235.98	1	4,716
Do.	do.	236.01	1	4,686
Do.	do.	236.07	1	4,666
Do.	St. Regis Borgia river, 1st crossing	236.11	1	4,614
October 29	Point intermediate	236.26	1	4,634
Do.	do.	236.31	1	4,620
Do.	do.	236.36	1	4,614
Do.	do.	236.43	1	4,600
Do.	do.	236.55	1	4,546
Do.	do.	236.65	1	4,538
Do.	do.	236.69	1	4,544
Do.	do.	236.75	1	4,526
Do.	do.	236.84	1	4,532
Do.	do.	236.87	1	4,534
Do.	do.	236.96	1	4,539
Do.	do.	237.01	1	4,531
Do.	do.	237.21	1	4,391
Do.	do.	237.29	1	4,371
Do.	do.	237.30	1	4,358
Do.	do.	237.32	1	4,364
Do.	do.	237.44	1	4,320
Do.	do.	237.47	1	4,328
Do.	do.	237.50	1	4,363
Do.	do.	237.64	1	4,276
Do.	do.	237.69	1	4,280
Do.	do.	237.78	1	4,253
Do.	do.	237.86	1	4,242
Do.	do.	237.91	1	4,253
Do.	do.	237.99	1	4,221
Do.	do.	238.06	1	4,206
Do.	do.	238.11	1	4,236
Do.	do.	238.24	1	4,194
Do.	do.	238.35	1	4,136
Do.	do.	238.43	1	4,129
Do.	do.	238.47	1	4,118
October 29, 30	do.	238.56	3	4,105

Table of heights—Continued.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Heights above sea level.
1859.		*Miles.*		*Feet.*
October 30	Point intermediate	238.68	1	4,100
Do	St. Regis Borgia river, 2d crossing	238.75	1	4,092
Do	Point intermediate	238.79	1	4,085
Do	do	238.88	1	4,084
Do	do	238.98	1	4,070
Do	St. Regis Borgia river, 3d crossing, 3d branch	239.00	1	4,056
Do	do 4th crossing	239.06	1	4,033
Do	do 5th crossing, 2d branch	239.15	1	4,016
Do	do 6th crossing	239 18	1	4,009
Do	Point intermediate	239.20	1	4,016
Do	do	239.27	1	4,007
Do	do	239.34	1	4,002
Do	do	239.37	1	3,994
Do	do	239.45	1	3,983
Do	do	239 62	1	3,967
Do	do	239.69	1	3,961
Do	do	239.83	1	3,938
Do	do	239.90	1	3,947
Do	do	240.05	1	3,909
Do	do	240.11	1	3,880
Do	St. Regis Borgia river, 7th crossing	240.39	1	3,871
Do	Point intermediate	240.44	1	3,838
Do	do	240.52	1	3,825
Do	do	240.68	1	3,830
October 30, 31	do	240.70	3	3,833
October 31	Small creek	240.82	1	3,827
Do	Point intermediate	240.88	1	3,825
Oct. 31 to Nov. 5	do	241.00	13	3,816
November 5	St. Regis Borgia river, 8th crossing	241.17	1	3,790
Do	Point intermediate	241.44	......	3,778
Do	do	241.70	......	3,766
Do	Creek	241.96	......	3,746
Do	Point intermediate	241.97	......	3,732
Do	St. Regis Borgia river, 9th crossing	242.04	......	3,739
Do	do 10th do	242.24	......	3,717
Do	Point intermediate	242.32	......	3,712
Do	do	242.73	......	3,697
Do	Creek	242.75	......	3,680
Do	Point intermediate	242.97	......	3,659
Do	St. Regis Borgia river, 11th crossing	242.99	......	3,649
Do	do 12th crossing, right bank	243.33	......	3,645
Do	do 12th crossing, left bank	243.38	......	3,646
Do	Point intermediate	243.54	......	3,622
Do	St. Regis Borgia river, 13th crossing	243.60	......	3,621
Do	Point intermediate	243.87	......	3,604
Do	St. Regis Borgia river, 14th crossing	243.88	......	3,586
Do	do 14th crossing, left bank	243.92	......	3,602
Do	Point intermediate	243.93	......	3,585
Do	do	243.94	......	3,604
November 5 to 9	do	244.28	......	3,607
November 9	St. Regis Borgia river, 15th crossing	244.33	......	3,613
Do	Point intermediate	244.47	......	3,604
Do	St. Regis Borgia river, 16th crossing	244.56	......	3,618
Do	Point intermediate	244.61	......	3,600
Do	do	244.64	......	3,619
Do	do	244.87	......	3,595
Do	do	244.93	......	3,600
Do	St. Regis Borgia river, 17th crossing	244.95	......	3,597
Do	Point intermediate	245 00	......	3,580
Do	St. Regis Borgia river, 18th crossing, 1st branch	245.10	......	3,585
Do	do 18th crossing, 2d branch	245.14	......	3,595
Do	do 19th crossing	245.23	......	3,565
Do	Point intermediate	245.27	......	3,566
Do	do	245.37	......	3,586
Do	St. Regis Borgia river, 20th crossing	245.40	......	3,567
Do	Point intermediate	245 43	......	3,555
Do	St. Regis Borgia river, 21st crossing	245.52	......	3,574
Do	do 21st crossing, right bank	245.53	......	3,559
Do	do 22d crossing	245.59	......	3,580
Do	do 23d crossing	245.70	......	3,540
Do	do 24th crossing	245.86	......	3,538
Do	Point intermediate	246.19	......	3,514
November 9 to 11	do	246.24	......	3,510

Table of heights—Continued.

Date.	Station.	Distance from Fort Walla-Walla.	No. of observations.	Heights above sea level.
		Miles.		*Feet.*
November 11	St. Regis Borgia river, 25th crossing	246.32	.....	3,490
Do.	Slough	246.81	.....	3,452
Do.	do	247.29	.....	3,434
Do.	Point intermediate	247.52	.....	3,409
Do.	St. Regis Borgia river, 29th crossing, left bank	247.66	.....	3,490
Do.	Point intermediate	248 12	.....	3,485
November 11 to 20	do	248.83	.....	3,486
November 20	St. Regis Borgia river, 46th crossing	245.86	.....	3,106
1860. January 20	Cantonment Jordan	257.85	.....	3,067

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby placed in general charge of the fatigue party detailed for work in the construction of the military road from this point, eastward, to Fort Benton, and as soon as your boats are constructed, and the ferry established across the Bitter Root river, you will push the work vigorously ahead to the Hell's Gate defile. Relying upon your good judgment and identity with our work, I can only trust that the best results will be obtained at your hands, and that we shall be possibly enabled to reach the Missouri in time to meet the steamer from St. Louis, on her arrival at Fort Benton, in July next.

While the party is on the river your men can assist in grading the banks of the Bitter Root river, at the ford, and at the ferry landing.

I am, sir, respectfully, your obedient servant,
JOHN MULLAN,
1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

Lieut. JAMES HOWARD, *3d Artillery U. S. Army.*

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: Having found it necessary to proceed in person to the Bitter Root valley to start a pack train for Fort Benton, to examine the line of road ahead, see the Indians, and attend to such matters as are essential to the interest of our enterprise, I hereby turn over the command of the expedition to you during my absence. I shall return by 1st April.

The different parties have been arranged for work to the best advantage, and detailed instructions given to the chief of each party. Whenever you may think that the road, hence to the mountain, can be worked to advantage, you will detail the fatigue party under Mr. Mitchell, and set them to work on the road. I can only trust that your good judgment and experience will so direct each and every detail, that the best results may be attained that look forward to the successful completion of our work.

I am, sir, respectfully, your obedient servant,
JOHN MULLAN,
1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

Lieut. JAMES L. WHITE, *United States Army.*

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby placed in general charge of all the civilians for the construction of the military road from the crossing of the Bitter Root river eastward.

As soon as the party shall have its provisions and baggage on the river you will set the carpenters at work, and construct a flatboat forty-two feet long and twelve feet broad, in the clear, from the material already sawed out at the crossing. You will also construct five flat-bottom boats fifteen feet long and two and a half feet broad, in the clear, in the bottom. Two of these will be for the moving of your party, two for Mr. Spengler, and the fifth for Mr. Kolecki. You have the material already sawed out at the crossing. As soon as the ferry is established you will proceed with the work with all vigor up the Bitter Root river, in connexion with Mr. Spengler's party. You will move with boats as far as "Brown's cut-off," when I trust the grass will be sufficiently high to enable me to move your party with a pack train. When you have finished with the boats, you will send them back to the crossing in charge of Mr. Hildreth.

I shall rely upon your energy and judgment to push on the work as vigorously as possible.

I am, sir, respectfully, your obedient servant,

JOHN MULLAN,
1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

DAVID WILLIAMSON, Esq.

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby placed in charge of the stores, storehouse, and ferry, at the crossing of the Bitter Root river. You will issue provisions to the workingmen as chiefs of parties shall call for them.

You will see that the boats are properly cared for, and white persons and Indians will have the free and willing use of the boats at all hours. You will lend every co-operation and aid to such persons, citizens, and others, as may desire to cross the ferry, and, by a good understanding with the Indians, promote the best results for the expedition.

I am, sir, respectfully, your obedient servant,

JOHN MULLAN,
1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

MR. HILDRETH.

CANTONMENT JORDAN,
Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby placed in charge of the fatigue party of twenty-five men for the construction of the road from this place to the mountain, between this and the crossing of the Bitter Root river, and you will take the field at such a day as the snow will allow the men to work to advantage; which day Lieutenant White will designate, and who, then, will make the necessary details.

I shall rely upon your pushing the work ahead with vigor to completion, and sincerely trust on my return from the Bitter Root valley, to find you far advanced in your work.

I am, sir, respectfully, your obedient servant,

JOHN MULLAN,

1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

S. C. MITCHELL.

CANTONMENT JORDAN,

Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby placed in charge of the surveying party about to take the field for the mapping of the line hence to Fort Benton. Mr. Smith, civil engineer, assisted by Messrs. Smith, J. A., and Townsend, will have charge of the level line, and you will co-operate and confer with him regarding the necessary movements of the party. You will endeavor to map the country on both sides of the line as far as possible, and from your experience and identity with the expedition, I can only anticipate the best results from your present duties.

I am, sir, truly, your obedient servant,

JOHN MULLAN,

1st Lieut. 2d Artillery, U. S. Army, in charge of Military Road.

THEODORE KOLECKI, *Top. M. W. R. Expedition.*

CANTONMENT JORDAN,

Bitter Root Mountains, W. T., February 20, 1860.

DEAR SIR: You are hereby assigned to duty with Mr. Kolecki's party, in charge of the level, with Mr. Smith and Mr. Townsend as assistants and rodmen. You will begin at the crossing of the Bitter Root river, and push forward your work with vigor from day to day, up the Bitter Root river, until such a time as the trains can move, or until the road will be opened between this point and the crossing, when you will return and complete the work between this point and the Bitter Root, and afterwards you will continue the work up to the Hell's Gate and eastward.

On the line of the road, from point to point, you will make cross-sections, that will go to show the detailed character of the work, and bench-marks will be established at the more prominent points. You will note in your level book every fact that you may notice, and particularly those bearing upon the solution of the problem of a railroad location along the Bitter Root river. You will note the character of both banks, and, possessed of the material for a profile on the right bank, you will endeavor to form the best possible judgment of the location along the left bank, in case it will be found best to cross the Bitter Root with the railroad line. You will notice the best points for crossing, the depth of water, the force of current, and the maximum height of high water, the character of the banks for abutments, &c. You will notice the localities, quantities and character of the forest growths for building purposes, the rock formation that may be convenient and suitable for railroad material. You will notice the number and character of ravines requiring culverts, and the general character of the earthwork along the line. In a word, each and every fact bearing directly or indirectly upon the railroad question will be noticed, and on the completion of your work you will make a written report on the same.

Supplied with profile paper, you will keep your work plotted up day by day in the field, and for the allowance to be made for odometer revolutions you will take for your guidance the results deduced by experiments by Captain De Lacy and Mr. Howard, civil engineers.

Mr. Kolecki being in general charge of the party, you will confer and co-operate with him in your general work, and from your good judgment and experience I can only look forward to the best results attending your present survey.

I am, respectfully, your obedient servant,

JOHN MULLAN,

1st Lieut. 2d Artillery, U. S. A., in charge of Military Road.

George H. Smith, *Civil Engineer.*

Cantonment Jordan,

Bitter Root Mountains, W. T., February 20, 1860.

Dear Sir: You are hereby placed in charge of the fatigue party of twenty-five men for the construction of the section of the road from the crossing of the Bitter Root westward to the spur of the mountain between this point and the river. You will push the work forward with vigor, as far as the snow and frost will allow you, and the work will continue until you meet the party under charge of Mr. Mitchell. Whilst engaged in this work you will avail yourself of the first good opportunity to make a survey of the Bitter Root from the crossing to the Clark's Fork, and the country on both sides. Provided with an odometer and wheelbarrow, constructed for the special purpose, you will measure the distance along the river, and if you should deem it necessary, you will take one of the boats at the crossing for the survey of the Bitter Root river. You will note every fact and feature of the country, and on the completion of your field-work will make a map and report of same. I rely upon your energy and good judgment for the best results.

I am, sir, respectfully, your obedient servant,

JOHN MULLAN,

1st Lieut. 2d Artillery, U. S. A., in charge of Military Road.

Capt. W. W. De Lacy, *Civil Engineer.*

Cantonment Jordan,

Bitter Root Mountains, W. T., February 20, 1860.

Dear Sir: You are hereby assigned to duty, with the fatigue party of twenty-five men under Lieutenant Howard, for the construction of the military road from the crossing of the Bitter Root to Fort Benton.

You will exercise every vigilance over the party, and your best judgment in pushing forward the work; you will move with boats as far as "Brown's cut-off," when, I trust, the grass will be sufficiently high to enable me to send you a pack train.

I can only trust that your identity with the work, and a desire to reach the Missouri at the earliest day, will be sufficient incentives to induce you to push the work ahead as vigorously as possible.

I am, sir, respectfully, your obedient servant,

JOHN MULLAN,

1st Lieut. 2d Art., U. S. A., charge Military Road.

Mr. C. Spengler.

FORT OWEN,
Bitter Root Valley, W. T., January 8, 1860.

DEAR SIR: In conformity to your instructions of November 5, 1859, to make a reconnaissance eastward from the St. Regis Borgia river to Fort Benton, in order to ascertain, in detail, the character of the line for the proper location of the military wagon road, and in order to arrange the working parties for spring operations, and at the same time collect data regarding the climatology of the main range of the Rocky Mountains in midwinter. I left your camp November 7, 1859, then established at Eleven-Mile prairie, on the St. Regis Borgia river, with Major John Owen, Indian agent for the Flathead nation, and reached Fort Owen, after seven days' march, on the 13th, estimating the distance at one hundred and thirty-two and five-tenths miles. The weather becoming very cold, and the snow falling continually, we had, in that short journey, many little difficulties to overcome, which delayed us considerably, and thereby impressing me with the idea that a reconnaissance, under such circumstances, would bring but poor results. I therefore, November 14th, addressed you a note in which I stated the disadvantages under which I had to undertake the work, mentioning at the same time that I would remain at Fort Owen until I received further instructions from you. A sudden change in the weather induced me, however, to determine to start; but the difficulty to find a person who knew the wagon road route delayed me until the 22d of November, at which date I left Fort Owen accompanied by C. C. Irwine, esq., two laboring men, with six riding and four pack animals. I made that day twenty miles against a strong cold north wind, and camped on the Bitter Root river.

November 23.—Two of the riding animals belonging to Mr. Irwine and myself had strayed away during the night. I made a late start, 9 a. m. Mr. Irwine directed Mr. Jacobs to take the two missing animals, in case they should be found, to your camp. At 11 a. m. I made the upper Hell's Gate crossing, at which place the river is divided by an island. The stream was heavily floating with ice, and the crossing rendered difficult by a strong ice cover extending from both shores some twenty feet into the river. The day was cold, and a strong wind blew from and through the cañon. In three-quarters of a mile we came to Rattlesnake creek, which is one-quarter of a mile from the mouth of the cañon, and found much difficulty in crossing it on account of ice. From here the ground rises very gradually for one and a half miles; at the end of which a steep descent of some sixty feet, to the lower plateau, would require some work. If the road is kept, however, near the river, which will occasion a little detour, this place can be avoided; and the ground being gravelly and loose, any earthwork in the lower portion of the defile would be easily and quickly accomplished. We passed over said lower plateau for one-half of a mile, and then came to a steep ascent, (60 to 80 feet,) which cannot be avoided. Here is a kind of ridge running towards the river, with an almost level top of forty yards in width; at the foot of its westerly side, which has a steep slope of sixty feet, the road crosses a small creek, the ascent on the other side being twenty-five feet; then three-quarters of a mile level ground, then cross White Thorn creek with almost undistinguishable banks, then one mile level ground about thirty feet above the surface of the water, thence to the crossing of the Big Blackfoot river, twenty yards above its mouth. No difficulties for wagons to get in and out of the river; depth of water two feet in the channel. Between this river and the first Hell's Gate crossing, which is five and one-quarter miles distant, the road leads through open timber and over level ground. Two creeks have to be crossed—the second one with miry bottom. After making the river crossing, which is a good one, the character of the country is in every respect favorable for wagons, the ground being firm, level, and is covered with open timber for two miles. I then reached the second crossing; the river here forms many arms, which overflow at times the enclosed islands and render them miry in places Then for three fourths of a mile through open timber to a little creek; one-fourth mile from there reached a prairie one and three-fourth mile in length and one-half mile in width; at the end of which I crossed a little creek and went to camp. Made twenty-three miles; snow on the ground about two inches deep; great many icy places on the road to-day, where the snow has melted and frozen again. A little snow fell towards evening.

November 24.—It snowed during the night. We started 9 a. m. in quite a heavy snow-storm; after three miles' travelling through open timber came to a prairie three miles long; at the end of which we crossed the river, (third crossing,) which forms an island; and one and one-tenth mile further crossed Rocky creek at a point where it also forms an island.

This creek is rapid, large, two feet deep, with big boulders in its bed; then three and a half miles open timber; then three-quarters of a mile over ground which cannot be called either prairie or timber land, the trees standing at such a distance from each other that the road can be located without difficulty; thence to the fourth crossing; thence three-quarters of a mile through timber with much underbrush; thence across a prairie, three and a half miles long, to a creek which runs along Beaver-Tail point; this last being a tolerably high and steep hill, which will require some work to make it practicable for heavy wagons. The hill forms a single spur of half a mile in width, terminating at the river in a perpendicular bluff. The present wagon road makes here two crossings of the river to avoid this place, (fifth and sixth;) then one mile and a half over prairie bottom to the river crossing, fifth by the trail and seventh for the present wagon road. This crossing might be avoided by keeping the road on the right bank, but it would require some earthwork, and the bridging of a little creek which runs in a steep ravine. This creek has been named "Gold Creek," as Colonel Lander is said to have found gold specimens in it. A quarter of a mile from the fifth crossing (by trail) a bad slough has to be crossed; then a mile and a quarter over prairie bottom to the sixth crossing. (eighth by present wagon road;) then a quarter of a mile over prairie to little creek; then a quarter of a mile over prairie to seventh crossing, (ninth by present wagon road;) then one-fifth of a mile, through open timber, to the eighth crossing, (tenth by present wagon road;) then the trail takes over a side hill about 250 yards from the last crossing. The wagon road keeps in the bottom and makes the eleventh crossing a little below where the low-water trail crosses. The wagon road would then make the twelfth crossing; then for half a mile through open pine timber, and then over a fine prairie, a quarter of a mile in length, to the 13th crossing. Instead of following the low-water trail, which here forks, one fork making the river crossing, the other winding around the rocky bluff which springs out into the river, I took to the high-water trail, which led me high on to the hill-side. This trail turns, after striking the above-mentioned prairie, over a little swelling of the bottom to the river crossing; then half a mile through the bottom, which is cut up by a miry slough, towards the hill bluff, which has a steep slope. At this point the wagon road will keep a little to the south or right of the trail to gain the saddle of the projecting ridge, where some earthwork, that cannot be avoided, will be required, and which has offered a great deal of difficulty to all the wagons which have yet come from Fort Benton. Reaching the opposite foot of this hill, which is a quarter of a mile from base to base, the road gains in three-quarters of a mile, passing over prairie ground, a slough which is said to be very bad in summer time; then strikes over a prairie three miles long, called "Cold Prairie," to a ridge running in the same direction as the first one. This spur, which is not so high as the previous one, can be avoided by the wagon road by keeping close to its foot. This, though, will involve a detour of three-quarters of a mile, and I think, with little work, the ascent of it can be made by taking advantage of a little ravine which runs up the hill side close to the trail. After reaching the top of the hill a very gradual descent of half a mile over prairie ground brings the trail to a little creek; then three-quarters of a mile over prairie to an old river bed, or to a lower river bottom; then half a mile along this bottom to camp. Made 27 miles; snow two and a half inches deep; it snowed a little towards evening.

November 25.—Snowing all night and still continued this morning. Started at 10.10 a. m., our horses having strayed; cold day; passed over the prairie bottom for three-quarters of a mile; then the trail takes to the hills, and crosses in half a mile a small creek. The wagon road can avoid this hill by keeping around it and striking the trail again about half a mile beyond the creek crossing; then, for a mile and three-quarters over rolling prairie ground, to two little creeks which run close to each other, and only separated by a small elevation. Both these creeks have miry bottoms; the Hell's Gate river being separated by a bare ridge from the road, and is completely hidden from view. Then for half a mile over rolling prairie to another creek, taking immediately after crossing it to a considerable prairie ridge coming from the south, and forming a connexion with the hill range which separates the road from the Hell's Gate bottom, where some grading will be required, but it is light work. Following that ridge for two miles and a half, in an easterly direction, with its ups and downs, all of which will require some side hill cutting, we reach a small creek; then over a small gently sloping hill to a small spring branch, (from creek to creek about eighty yards;) then take to the opposite hill where also some grading will be found necessary, and in one-fifth of a mile reach a second spring. Ascending the next hill, requiring side hill cutting, the Flint creek valley lays before us, whence commenced the gradual descent, and reached it after four miles and three-quarters travelling. Flint creek has little wood on it; but still good camping places may be found above the crossing. The creek is two and a half feet deep, but the banks not high. After crossing Flint creek in one-tenth of a mile we crossed a small branch of it; then for a quarter of a mile through the valley bottom; thence three-quarters of a mile over rolling prairie hills, forming the river bluffs of Hell's Gate river to the valley itself. The descent from these prairie bluffs at the place where the trail strikes it is rather steep, and requires cutting; but I am confident that, by a little examination, a better place could be found. Following up the Hell's Gate bottom for a mile and a half, I camped on a creek. After crossing it the trail bends about, according to the shape of the creek, which makes an elbow towards the north; in two miles and three-quarters cross a second creek, and then follow up the valley for three miles and a quarter, winding part of the way around the swampy bottom of the river—this portion of the valley being cut by a great many dry ditches, all of which are filled up with drifted snow, often to the depth of four feet. The snow in the valley is five inches deep. The trail is unbroken, and our animals had hard work to keep up a good marching trot. After crossing a hill spur of three-quarters of a mile in width, with gentle slopes on both sides, I took up the bottom again for two miles and a quarter, and then went to camp. Made twenty-two and a half miles. The day was clear, but cold. The prairie bluffs are almost free from snow, which has been deposited by the wind in the valley. I am confident that the wagon road can be located in such a manner as to run almost as straight as the valley, which is a mile and three-quarters wide, and the river bed, though winding much, keeps well to its centre, without touching the bluffs.

November 26.—Started at half past eight a. m.; two mules have strayed off; cold morning; snowed heavily; travelled one mile through a bottom; then crossed "Humbug creek," which has a fine valley running towards the pine clad mountains. Crossing this valley we reached, after three-eighths of a mile, the fourteenth crossing of the Hell's Gate river, which we made on the ice. All the former crossings, and that of the Big Blackfoot, are rocky. Flint and Humbug creeks have offered us more or less difficulty, as the shores were frozen on both sides, requiring a leap from the ice into the water and out again on the icy shore, which always endangered our animals, the ice being bare of snow. Hell's Gate river here is a bold, rapid stream, from eighty to one hundred yards wide, with a channel of two feet in depth. After making the crossing I travelled for two hundred yards over a prairie bottom; then crossed a small timbered point; then took to a little hill which will require some side-hill cutting. The present wagon road makes at this point two crossings, not more than a hundred and twenty yards apart. The road, after leaving this side hill, will require more work, being rocky and larger than the first one mentioned. At this place the wagon road makes two more crossings of the river; then a quarter of a mile over prairie bottom to a place where the road winds for a hundred and eighty yards around the side hills, to avoid the crossing of a miry slough, formed by a spring around those hills, which are a little sideling; very little work will make this a good road; then for a mile and a quarter over level prairie up a bottom; then cross a creek; then follow up a prairie bottom for one-third of a mile; then cross a coulée, which wagons can avoid by keeping to the left of the trail; then go up the bottom for three-quarters of a mile; then cross a little hill-spur, which may possibly require grading; then for two hundred yards, over prairie bottom, to a creek; then up a level prairie bottom for two miles and a quarter; then the river takes a short turn to the south, where the trail forks, one passing up Deer Lodge valley. The wagon road here leaves the river, and crossing the valley takes to a gently sloping side hill, and after a mile and a quarter strikes the Little Blackfoot river about a mile and a half above its junction with Deer Lodge creek. From the top of said hill the junction of these waters can be seen, and also the lower portion of the big valley. None or very little work will be required to bring heavy wagons up to the top of the hill without doubling teams; but it may be that some winding about in the descent would be necessary, as some deep hollows cut up the easterly slope. We encamped one-half mile from the foot of the hill in the bottom of the Little Blackfoot valley, having made eight and a half miles. Mr. John Grant has settled near the junction of the two branches of the Hell's Gate river and built two log houses. It snowed since 4 a. m., and for some time pretty heavily. At 11 a. m. it cleared off. The snow is not so deep here as below, measuring three inches on a level.

November 27.—Very cold morning; started 9.45 a. m; had much delay in finding the animals. For one mile we passed over a prairie bottom; then one-eighth of a mile over a side hill, which will require cutting; then one-eighth of a mile up a bottom, partly through brushwood; then winding for a quarter of a mile around the river bluffs, where work will be necessary; but in keeping the road along the right bank six crossings of the river would be avoided. Gaining the hill slope the road strikes in one-half mile a creek, and crosses in one-half a mile further a second one, the intermediate space being slightly undulating ground. After ascending a gently sloping hill, I followed its rolling surface for two and a quarter miles, and then began the very steep descent. Here a careful examination of the ground would have to be made to find the best location for the wagon road. This descent of about 350 feet offers one of the greatest difficulties on the whole route. Of the two ravines to the right and left of the trail, one or the other may be adapted to the purpose; if not, considerable work, similar to the descent to the St. Joseph's river, will be found necessary. After reaching the foot of the hill, the road passes up the river bottom for three-quarters of a mile and crosses at the end of that distance the Little Blackfoot river at a point where it forms a timbered island one-quarter of a mile in width. Both crossings are good and with gravelly bottoms; depth of water, about one foot and three-quarters; and width, from fifteen to twenty feet. The opposite hill, which the road has to cross, is called the Mountain, and is said to be more formidable than the divide of the Rocky

Mountains. From the foot to the top of the hill the distance is one-eighth of a mile, and I am confident that by two turns, which will involve some side hill cutting, a good and easy grade can be attained. The present road does not ascend the hill at the place where the trail is located, but keeps for one mile further up the valley, which forms here a kind of cañon, and then ascends a hill by taking advantage of a coulée which runs up to the top of the mountain. With little work it is said that a good road can be made there; but it will make four river crossings necessary. From the top of the hill for three-quarters of a mile we pass over gently rolling ridges to a timber point of one-tenth of a mile in width. One-quarter of a mile further, over ground of the same character, when we gain the topmost ridge, then commenced the very gradual descent, over undulating surface, towards the Little Blackfoot river valley, which I gained in two and a quarter miles. At the foot of the last slope we crosed Irwine's creek, which has miry shores. At this point the wagon-road could (after crossing) follow down the bottom of that creek; then cross the Little Blackfoot river and strike over an apparently easily graded hill towards the north fork of the Little Blackfoot river. This road, though, is said to be a bad one in its present condition, but is worth examining, as it would save four or five miles in distance. The present wagon road takes, in one-quarter of a mile after crossing the bottom of Irwine's creek, to a gradualy ascending hill spur, (surface being covered with stones,) which it follows for one and a half miles, requiring no work at all to bring wagons over; then cross Buffalo Head creek; then follow up the level bottom of the Little Blackfoot for one and a half miles, reach a slough, and in one mile further a second one, which must be very bad in spring and summer. In three-quarters of a mile, still following up the valley, I crossed the Little Blackfoot river at Belknap's camp, after passing a plateau which is elevated about six feet above the level of the valley. Ascending the almost level valley on the right bank of the river, I reached, in three and a half miles, a kind of terrace or high bottom, 250 feet in length, and terminated by the prairie bluff coming in close to the river and forcing the present wagon road to make two crossings. With little work the road, though, can be kept on the right bank. Passing this side hill the ground is level for a quarter of a mile, and then another side hill closes in, which will require some work for eighty-five to ninety yards. At this point two more crossings are made by the wagon road. In order to avoid a small rocky ridge which springs out into the valley, the road turns to the northeast, and passing the saddle of the ridge, crowned by a few pine trees, strikes, in three-eighths of a mile from the turning point, the north fork of the Little Blackfoot river. The forking point is about a half a mile below. Here again the present wagon road crosses the river twice to avoid two side hills, which, in the space of half a mile, runs in towards the river. I think, though, that the little work which would be necessary to keep the road on the right bank would not justify the crossing of the river, which seems to have miry shores. Having made nineteen miles, we encamped. The day was very cold, and towards evening a chilling northeast wind made the cold still more severe. Snow varies in depth from two to four inches.

November 28.—Started at 9.20 a. m; cold but clear morning; passed up the valley for 200 yards; then turn a sharp side hill, and immediately afterwards ascended a very sideling hill, three-quarters of a mile point; then up the valley for one and one-third mile, which becomes very narrow, the trail winding for the last three-quarters of a mile around the side hill. The wagon road, though, as the ground appears, can keep lower down, thereby avoiding work. At the end of that distance, a bad rocky point has to be passed, and I think the wagon road could cross here with advantage to its location, and keep for three-quarters of a mile on its left bank; first turning, at a distance of one-eighth of a mile, a gently sloping hill spur; and then crossing, one-half of a mile further up, a small tributary of the Little Blackfoot, where the road could recross to the right bank, at a fine prairie, where the valley widens considerably. The trail, which runs along the right bank, crosses, a half a mile from the last rocky hill spur, a creek, which runs in a valley leading north to a spot where the Little Blackfoot valley is strongly bending to the east. Should the road be kept on the right bank of the river, the work is loose rock around the point where I propose to make the crossing, and would extend from fifty to sixty feet. From there, for two and three-quarter miles, no earthwork would be necessary. A corduroy of thirty-five feet, over a wet place formed by a spring coming from a hill spur, would be needed. Two hundred and sixty yards from there another wet place, originating in the same manner, can be avoided by keeping close to the creek where the ground appears to be dry. I think it necessary that this portion of the road should be carefully examined, because the valley is said to be miry in the extreme during spring and summer, and probably here it will be inevitable to have to cut the road high up on the side hills. From the last-mentioned wet place for a half mile up the valley bottom requires no work; here the road must cross the creek and keep on its left bank all the way, as a long hill-spur, which would require a quarter mile earthwork, runs close to the creek for one and a quarter mile from where I propose the wagon road to cross. The trail crosses the creek also, and takes to the valley towards the divide, leaving the Little Blackfoot valley, which last extends northward to the mountains to the left. Following the eastern valley for one-eighth mile, I came to a ravine of one-eighth mile in length, which, though narrow, will offer no difficulty to the location of the road. Crossing the little water run which empties at the last-mentioned crossing of the Little Blackfoot, I passed for three-quarters of a mile over a level plain, which is situated just at the foot of the divide; then for three-eighths of a mile to the top of the divide, where I found the snow from four to five inches deep on the westerly slope—in some places it had a depth of from six to eight inches—and on the easterly slope with two to three inches. A strong northeast wind struck us as soon as we reached the above-mentioned plain, lulling only toward sunset. The natural slope of the ground through open timber will probably require no work, though in places the grade is somewhat steep.

At the foot of the divide, a quarter mile from the top, I struck the headwaters of Big Prickly Pear creek; one and three-quarters of a mile further, a little branch of running water, coming from the north, crosses the road, before reaching which a little side-hill cutting will be necessary, and also on the other side of it, at points where the hills come close to the creek, which runs in the hollow of the narrow valley. In three-quarters of a mile I crossed Stormy creek; 200 yards before reaching which the valley widens considerably, and affords good camping places. On the east side of Stormy creek the ground is level for three-eighths of a mile; then a side-hill cut of 20 yards will bring the road again on an almost level plain for three-quarters of a mile; at the end of which the wagon road leaves the Indian trail which leads along the Big Prickly Pear and takes to the north, over a small side hill covered with pedrigal rock, and in a half mile crosses a dry water run. In one-eighth mile further a second one is crossed; then a half mile, over a gently-sloping hill covered with large pedrigal rock, a third water run is crossed. Ascending now a gently sloping hill covered with a few red cedars, I gained, in a half mile from the last dry water run, the narrow valley of Fir creek, a tributary to the Big Prickly Pear creek. A few steep places in the descent will offer no difficulty for wagons. The ascent on the other side of Fir creek is very steep; but a ravine running to the right of the trail will facilitate the location of the wagon road. One-eighth mile is the distance from the creek to the top of the hill, which slopes very gently. We then travel for a quarter mile towards a dry pond, which extends to the next hill, of easy ascent and descent, the latter terminated by a dry water run; distance from the dry pond to the dry water run is three-quarters of a mile

The next prairie hill is tolerably high, and the grade so steep that doubling teams will be necessary for heavily laden wagons. At this ascent, if possible, the road should be located at another point, as the present trail is cut up by many narrow but deep coulées. Ascending a hill a quarter mile long, from the top of which we enjoyed a fine view of the Upper Missouri valley, the gate of the mountains, and a small portion of the Rocky Mountains, Heart mountain can be distinctly seen, and also the direction of the wagon road for 10 or 11 miles, to a point where it crosses Soft Bed creek. After crossing a dry water run, we passed over some rolling ground and descended to Silver creek, one of the tributaries of the Big Prickly Pear creek, thence to camp; distance from top of last hill to camp, four and a half miles. Made to-day 19¾ miles. Our animals are getting weak; the want of sufficient nourishment commences to tell on them. The day, which commenced cloudy, became clear as soon as the wind sprang up, and towards evening it became quite mild.

November 29.—Started 9.05 a. m. Our horses had wandered far off during the night in search of grass. Mild, cloudy morning. For five miles and three-quarters we passed over undulating, firm prairie ground, to a small creek with miry shores, bordered by small willows, whence its name, "Willow creek"; then two and a quarter miles over a very gently downward-sloping prairie, part of which is covered with brushwood, to Soft Bed creek, a branch of Small Prickly Pear creek, after crossing which I went up its valley in an easterly direction for two miles, at the end of which a little side branch will have to be crossed.

For the last half mile the side hills close in so narrowly to the creek bed that in some places hill-cutting will be found necessary; but the distances where such work is required are short and the ground not difficult. For one-fourth mile further the character of the ground remains the same as described, then, by turning a little more to the north, the road gains the hill-side, and, gradually ascending, reaches in two miles the top of a little divide. The road, before coming to the last ascent, leaves the trail to its right by taking advantage of a small ravine, which facilitates the ascent considerably. The valley on the other side is quite narrow, and remains so for one-half mile, until a point is reached where the creek will have to be crossed and immediately recrossed. A little work now and then, in this distance, will be necessary on points where the side hills are too much sloping. At this place the valley widens considerably, and a good camping place can be found for a large train. I suppose, though, that the valley must be wet, as the trail keeps on the westerly side hills, and recrosses the creek only three-fourths of a mile below, where the valley bends to the north. In 50 yards the trail recrossed and continued on the west side of the creek all the way to the Little Prickly Pear creek. In two and a half miles more it passes along an easy slope, which is occasionally cut up by small ravines, but offering no difficulty to the location of the wagon road. Little Prickly Pear creek, which runs, at the place where I struck it, in a large valley, is twelve feet wide and one and a half feet deep, the banks of which, in this plain, are lined with willows, but higher up and lower down larger trees will be found.

The creek, coming from the Rocky Mountain chain, cuts through a narrow cañon to gain the broad bottom, and in three miles forces its way through a Rocky mountain range, forming a narrow gorge. After crossing the creek, we proceeded in a northerly direction towards Medicine Rock. The day had become very warm, and we had hoped to have been able to reach "Mullan's creek" before dark; but after riding for one mile a sudden northeasterly gale forced us to seek shelter in the willows of the creek just crossed. In less than one-half minute our horses were covered with white frost, and the air was filled with an icy, foggy substance which, after some time, gave way to a heavy snow-fall. Recrossing the Little Prickly Pear we found a tolerably good camp in the willows, having made fourteen miles headway.

November 30. Remained in camp. The gale has not abated in the least, and the snow still falls heavily.

December 1. The night was cold and stormy. At 9 a. m. the sun broke through the clouds, and I started at 11 a. m. It was very cold, and the snow five inches deep. The road leading to Medicine Rock strikes, in three-fourths of a mile, a little creek, and following it up for one-half mile strikes the foot of the hill range, where the trail takes a very steep ascent, which the wagon road can make more gradually by keeping a ravine running to the left of the trail, when reaching the top of the first hill a good road with easy grade leads towards Medicine Rock, and in two miles from there descends to a small creek, called Medicine Rock creek, the descent to which will require some side-hill work in places where the slope is too steep. In three miles we reached Mullan's creek, where work will be required in different places, as the trail keeps along the side hills.

Two hollows, the first one pretty deep, will have to be passed, and a few trees to be cut to bring wagons through with four or five yoke of oxen. The ascent on the east side of the creek is steep but short, and then the character of the ground for two miles further remains the same as described. At the end of that distance the road leads towards Prickly Pear valley, thence over a bare hill, the descent of which in itself will offer no difficulty except at one point, which, for the present, is made passable by a couple of logs stretched from side to side of a low, rocky precipice, to give, in that narrow passage, the required breadth to the road. Reaching the valley, I crossed a creek coming from the west, one-half mile distant from the bending point of the trail on the top of the hill; then one-half mile through the bottom of the valley, keeping close to the hill-side, through which, in connexion with the vegetation of the valley, makes me believe that it is of a miry character. Taking again to the side hills, I reached, in two miles, the head of what is called Prickly Pear cañon, and went to camp. The last portion of the road will also require some side-hill work, which, in places, may prove more difficult as the ground is rocky. We made to-day 11$\frac{5}{8}$ miles.

December 2. The wind blew a perfect gale during the night. The morning is very cold and our animals appear much reduced. The snow in the valley is four inches deep and covered with a hard crust, which makes pawing the grass for the animals difficult. At the head of the cañon, through which the road passes, a small creek coming from the north empties into Prickly Pear creek, and I was told that by following up this creek a good road can be obtained, avoiding, thereby, all the crossings which are inevitable by following the Little Prickly Pear. In taking this direction a little detour might be made, but it is said that no obstacle of any moment would be in the way. Started at 9.25 a. m. At the entrance of the cañon, where the first crossing will have to be made, after having crossed the creek alluded to at its mouth, we found that the usually travelled road had been made impracticable by beavers. Finding a good place to cross, we followed the cañon for eight and a half miles, making seven crossings of the creek, all which were greatly obstructed by ice. The intermediate ground is partly covered with pine timber and partly with brushwood of different heights. After the seventh crossing the cañon becomes wider and forms a valley, affording ample space for camping places, with good grass on the low side hills for the animals. For one-half mile from the seventh crossing I reached the eighth, which is situated at the foot of the northerly hill bluff. All the crossings are shallow, with firm gravelly bottoms, and the banks offer no difficulty. After ascending the low bluff, which will be easily rendered practicable for wagons, the road leads over prairie ridges, with easy slopes, to a small creek, two and a half miles distant, which empties into the Missouri river a few hundred yards below the Little Prickly Pear creek. From the crossing point the road follows the creek for three miles, for which distance no work will be necessary, except at one point where the side-hills close in narrowly. At the end of this distance a low but steep ridge is ascended, before reaching which the wagon road must cross the creek and follow it for three-eighths of a mile, then recross and surmount the ridge, which is of easy grade and offering no difficulty by its slope. The descent, which terminates at a dry creek one and three-fourths mile distant, is in some places steep but not sideling. The next ridge, measuring from base to base three-fourths of a mile, is not so high as the previous one, nor is it as steep. After crossing a dry branch I reached in two and three-fourths miles, travelling over undulating ground which would require no work, another dry water run. At this point the above-mentioned road, which leaves the one here described at the head of the cañon, would again unite with the present wagon road. In three miles further I struck the Dearborn River valley, the ground being undulating prairie, and in one-half mile a small creek will be crossed; no characteristic can be mentioned regarding it. A high and well-timbered ridge to the eastward indicates the Missouri River valley, and a curiously formed hill range, lying to the north of the Dearborn, are good landmarks for the traveller who cannot form his course by the uniformly undulating plateau. The road will have to keep up the Dearborn river for half a mile, in order to reach the best crossing. Its valley is richly timbered, but cut up by a great many sloughs and ditches, which run in every direction. The river is a shallow stream of from 50 to 60 feet in width, with a gravelly bottom and swift current. The wind has been blowing hard and cold all day from the southwest. Made 17 miles. Snow five inches deep.

December 3.—It has been a windy night. Our tent was blown down, and we were fearful that some of the shallow-rooted trees would be blown upon us. This morning it is quite mild. Started at 7.45 a. m. to make Sun river in good time. The ground is gently undulating from the north bank of the valley to the crossing of Beaver creek, which is five miles distant. The road first follows a dry creek, crossing and recrossing it several times, and then leads over a wave-formed plain, which now and then is cut up by long, dry hollows. After crossing Beaver creek the trail commences the ascent of the divide between the Dearborn and Sun rivers, and, if I understood aright, the present wagon road keeps to the left, making a detour of four and a half miles, avoiding thereby the steepest portion of this rocky divide. Just as we commenced the ascent an icy northwest gale sprang up, driving before it a storm of small crystals, which made it almost impossible to keep the eyes open; and the wind continually increasing in force, we became doubtful whether our animals would be able to carry us to Sun river, and were obliged, after having made two and a half miles more, and nearly gained the summit of the divide, to turn back and seek refuge in a small ravine, where we found just wood enough to build a fire, and stow away our baggage. Made seven and a half miles. The storm continued with fearful severity; it was extremely cold, and the snow fell heavily. We had an idea that we might be caught here by a long, lasting snow-storm, which was anything but pleasant, as wood was scarce, provisions nearly exhausted, and our animals in a distressed state.

December 4.—The weather had not moderated in the least, and I judged that the thermometer must have been at about forty degrees below zero. It still snowed, but not so heavily as yesterday. We were undecided whether to push on to Sun river or go back to the Dearborn. To retrace our steps seemed the most sensible in our present condition, as we would have the wind in our backs, and in a short ride could reach shelter and food in a large Pend d'Oreille camp which we left at the Dearborn river; but then the snow might fall to such a depth that we would be cut off from Fort Benton. At 10 a. m. we decided to try to reach Sun River Farm, and at 11 a. m. started for that point. It was terrible weather, and we could distinguish nothing at a distance of 100 yards. After a ride of three and a half hours we reached Sun River Farm, which was twenty-three and seven-tenths miles distant from our last night's camp. We were all more or less frost-bitten, and had suffered extremely. Colonel Vaughan, Indian agent for the Blackfoot nation, received us very kindly, and with his well-known hospitality, offered us accomodations at the agency for any length of time that we might wish. The weather continuing very cold, and our animals requiring some rest after our last march, we remained at the farm during the fifth and sixth, and left on the seventh, of December. The cold being too severe to take notes on our march, I did so (for this portion of the road) on my return; but will give the description of it here, in order to keep the same travelling direction in mentioning the different objects of the road. From the crossing of Beaver creek to the top of the divide, which forms a narrow rocky gap, the distance is three and one-fourth miles. It is not one gradual slope, but the ascent is formed by a succession of hills of different grades and heights, which will occasion some work in a few places if the road should be located in that direction. Hitherto it has been thought a matter of impossibility to follow with vehicles of any description the Indian trail; but in coming back from Fort Benton I brought over it a two-wheel cart, and found but little difficulty. The descent on the other side is gradual, and is practicable for wagons in its present state. Bird Tail Rock creek, a little stream which bends near the divide, is followed down by the trail for one and one-fourth mile, and then, at a point where it turns short to the west, the trail takes for two and a half miles over prairie hills, until it strikes the creek again, and also the present wagon road, which gains the creek about one and a half mile below the above-mentioned turning point, and follows its valley downwards, crossing and recrossing the creek, which is made necessary by the closing in of the small side-hills. In three miles the trail comes opposite to Bird Tail Rock, a prominent peak of a mountain chain running between the trail and the Missouri river. Following the valley of the creek for three miles, I reached a low, rocky bluff, through which the creek has forced its way. Here a little side-hill work will be necessary, as also at some places above. In three and one-fourth miles, over an almost level plain, the road crosses Crown Butte creek, about two miles below the mouth of Bird Tail Rock creek, and gains in one and three-fourths mile a small rocky ridge, which is easy in its ascent; the descent is sideling, and encumbered by big boulders, which will have to be removed. The Big Knee, Crown, and Square Buttes, which have been in sight for some miles back, are now fully exposed to view. A kind of prairie saddle-ridge, which connects the Big Knee and Crown Buttes with a gentle slope, will have to be ascended. The road passing midway between these two prominent points, begins the descent, which is very gradual. The direction which I followed brought me opposite to the agency, but I think the wagon road must keep closer to the Big Knee, and strike Sun river about three miles below the farm, in order to gain a point where the crossing towards Teton river can be accomplished without distressing the teams. Sun river, which I crossed at a point where it forms an island, was frozen over. A luxuriant growth of cottonwood lines both sides of the stream at this place, and extends up it for some distance. Distance between the last-mentioned little ridge and Sun River Farm is eight miles. By information I learned at Sun river, that the distance to Fort Benton by the shortest route was estimated at 55 miles. At 19 miles from the farm, the road reaches a shallow lake, and seven miles further is a small spring, both of which are destitute of timber. In summer the lake often dries entirely up, and at all events becomes unfit for drinking or cooking purposes, besides that in both places it is strongly mixed with alkali. On the strength of those statements, I resolved to try to find a wagon road leading to camping places where wood and good water could be found, and concluded to strike the Missouri river somewhere below the Great Falls. The interpreter of Mr. Dawson being at the time at the farm, I accepted his offer to guide us to the fort.

December 7.—Started at 10.15 a. m. Mild weather. Followed down the Sun River valley for about 12 miles and then struck across an insignificant prairie ridge towards the Missouri river. Before I left the valley, which we did at a point about three miles above the mouth of Sun river, I crossed a deep ravine with running water 10 miles from the farm. After 18 miles we arrived at the edge of the prairie plateau, and had to accomplish the descent towards the Missouri river by following the winding of a coulée ridge, gaining the coulée bottom itself, which quickly enlarges to a narrow valley with a few cottonwood trees. We reached in one mile the river itself. We intended to follow down the Missouri for 1¼ mile further, and camp on a small prairie opposite the mouth of Highwood creek, but the river ice had blocked up the trail, and we were forced to remain where we were, having made 31 miles. The Missouri river is so poorly timbered between the mouth of Sun river and Fort Benton, that if a road could even be found in that direction, the greatest inconvenience for want of wood would ensue for small or large parties. During the night a furious gale forced us to secure our blankets and baggage with logs and rocks, and even those precautions proved to be insufficient.

December 8.—Started 9 a. m. Our guide advised us to head the coulées, and we therefore started back to gain a ridge about five miles to the northwest. The day was clear and warm. After a ride of 28 miles, during which we crossed the Grand and Eight-Mile coulée, and descending near Discovery Butte into the Missouri River valley, we arrived at Fort Benton, and were most kindly received. There was scarcely any snow here, but the river was frozen solid, which was a fortunate circumstance, as we could drive across our animals, that would have starved on this side. The necessity to give rest to my animals and some delay in my preparations for the return trip, induced me to remain seven days at Fort Benton, during which time I received from M. Clarke, esq., of Fort Campbell, a small howitzer belonging to the government, which I intended to bring over the mountain, and, with an odometer on the wheel, measure the road.

December 15.—Mr. Dawson having fitted out a party to accompany me to the Bitter Root valley, I started at 12 m. towards the Teton river, *via* Sun River agency. Colonel Vaughan, who arrived at Fort Benton on the 13th, directed his returning wagon to keep with us. The odometer was fastened to the cannon wheel, which measured 9 feet 10 inches in circumference. After ascending the Missouri River bluff, which has an easy grade, we followed a well-beaten wagon trail towards Teton river, over almost level ground, and struck said river in four miles. Before descending into the valley the road forks, one keeping along its right bank on the bluff, the other descending into the valley and following it up. Our guide for this portion of the road having been kept back at Fort Benton, we took to the valley, which afterwards turned out to be the longest and most troublesome road of the two, on account of the mirror-like frozen surface of the river. In $3\frac{7}{10}$ miles we made five river crossings, which delayed us considerably, as we had to throw earth on the ice to give our animals a foothold. No other difficulty for wagons was experienced. Made to day $7\frac{7}{10}$ miles, and encamped on Teton river. About two inches of snow on the ground: but the grass has been partly burnt and partly eaten off by Indian horses.

December 16.—Started 11 a. m. Our animals having strayed towards the Missouri River bottom, it took us a long time to find them. We made six crossings to-day with great labor. After following the valley for six miles we took to the north bluff, which offered an easy ascent, the top forming a large plain, and the river, which makes a wide bend towards the south, disappears out of view. In the distance the Teton Buttes could be seen. The trail taking a direct line towards the westerly end of the river bend, heads all the coulées, offering thereby an almost level road. In 5½ miles we struck the river again and descended its valley, and camped in 1½ mile further on the bank of the Teton. Baptiste Champaigne, our guide, who joined us this morning, informed me that one-fourth of a mile below, and opposite the spot where we struck the river valley again, the straight road from Fort Benton descended also to the valley, and that the distance to that place was ten miles, as estimated by Governor Stevens. Where that road strikes the valley the river will have to be crossed for the first time, gaining $9\frac{2}{10}$ miles in distance. Wood is plentiful, the valley large and covered with good grass. A rain-storm passed over us towards evening, changing by nightfall into snow. The snow kept up all night. Made 13 miles.

December 17.—It is still snowing. Started at 11 a. m. to-day. I attached the cannon to one of the wagons. The road follows the valley for three miles, where no other obstacle is offered but a little creek running in a hollow which can be made practicable in a few minutes' work; a second ditch at the place where the road leads towards the bluff will require the same amount of work. The ascent itself, formed by a gentle slope, requires a little side-hill cutting for a distance of 20 feet to make the road practicable for heavy wagons. The road on top of the bluff requires no work, being almost as level as a table. In 8¼ miles I gained the descent to the river, which will require a little side-hill cutting for a distance of 25 feet; half a mile further I camped, having made 12 miles. The day has been very cold; the snow kept falling heavily, and the wind blowing strong from the north. Snow 4 inches deep.

December 18.—Started 10 a. m. Clear and cold morning. At the start our wagons were obliged to make two river crossings to avoid a side-hill of 30 feet in length, requiring but little work to make it passable for wagons. In three-fourths of a mile from camp I came to the last Teton crossing, which, like the rest, was frozen over. The river is about 20 yards wide, and appears to have a gravelly bottom The banks at the crossing will require but little work. The trail, keeping now altogether on the south side of the Teton river, reaches, in seven miles, the ascent to the low prairie plateau, and here the wagon road could with advantage strike in a southwesterly course towards Sun river. If that course should be adopted, Mud creek, a tributary of the Teton river, with ample wood and water, would afford a good camping place. This creek, which, in its easterly branch, reaches high up towards the divide of Sun and Teton rivers' waters, would enable trains to shorten the long journey between those two rivers considerably, indicating, at the same time, the direction which will have to be followed to strike the place where the two rivers come closest to each other. Two long prairie buttes on the top of the divide would serve as good landmarks, and in leaving the most easterly one of the two to the west, the right course could not well be missed. Sun river at this place, about 28 miles from the Teton, would be reached at a spot where a creek empties into it about 4½ miles below the Indian agency. It is said that no coulées intercept the direct course of the above-described road, and that the ground is favorable in every respect. Sun river could be crossed at the point where it is struck, or followed up to the farm and crossed. Trains reaching here would be obliged to take in wood, because the rest of the timber to be found would only be on Dearborn river, which is $31\frac{2}{10}$ miles distant from the farm. The whole distance from Fort Benton to Sun river would, by the above-mentioned route, amount to 57¾ miles, being 13 miles longer than by the prairie lake; but good water, plenty of wood, and convenient camping places would be secured to the road. Unfortunately for us, our guide took us to the westerly branch of Muddy creek, which we struck in 2½ miles from the ascent to the prairie plateau. Made 10¼ miles. Found sufficient wood and water, and good grazing.

December 19.—Started at 10 a. m., and took our course southward to a pass between the two high buttes which crown the dividing prairie ridge. A gradual ascent brought us, in three hours, to that place, and finding that the distance to Sun river was considerable, we pushed on with the pack train, Mr. Irvine remaining with the wagons. After crossing three deep coulées, we arrived, at 5¼ p. m., at Sun River Farm, having marched at a brisk gait for the last 16 miles.

A cold and strong wind set in early in the afternoon. Made $32\frac{9}{10}$ miles. Mr. Irvine having left the wagons, on account of darkness, at the first coulée, arrived with the animals at 8 p. m.

December 20.—Animals started out for the wagons in a heavy snow-storm, but returned after an unsuccessful march.

December 21.—Sent a man over to the Teton mission to obtain a cart, as the peculiar construction of the cannon does not allow of its being carried any further without the risk of injury to our mules. A renewed attempt was made to bring the wagons in. They were found, but plundered by some Indians.

December 22.—The cart came in, and we caught up all the animals to make an early start. Mr. Dawson and my party numbered, altogether, eight men, with thirty-nine animals.

December 23.—Some animals that had run off during the night delayed our start until 11 a. m. The day was clear and warm; Sun river, however, is still frozen over. At noon a west wind sprang up, augmenting hourly in strength. Made thirteen and two-tenths miles to-day, and camped on Bird Tail Rock creek. Snow two inches deep.

December 24.—Started 10 a. m. Clear and warm, but with a strong southeast wind blowing almost a gale. Snow is getting deeper and deeper the nearer we approach the little divide, on the northeasterly side of which we found it five or six inches on a level, with drifts of many feet in depth. On the south side was eight or nine inches of snow, and still increasing towards the Dearborn river, at which stream we encamped, having made eighteen miles.

December 25.—Started 9.15 a. m. Cloudy and warm; the snow is increasing in depth at every mile we make, and at Little Prickly Pear creek we find it from twelve to fifteen inches on a level. The drifts are almost impassable for a vehicle, and our animals are getting very tired. I am obliged to cache the cart at the south side of the lowest Prickly Pear crossing, where I camped, having made fourteen and three-fourths miles.

December 26.—Started 10 a. m. Our animals had poor feed last night. Cloudy and warm morning; clear towards noon. The crossings in the cañon are partly frozen, making them difficult. Snow from sixteen to twenty inches deep. No trail is broken, and our animals have hard work. On the top of the Medicine River divide we found twenty-six inches of snow, and camped on Little Prickly Pear creek one and a half mile higher up than I did on my outward trip, having made fifteen and five-tenths miles.

December 27.—Started 10.15 a. m. Clear and cold morning. The snow is badly drifted, and has on a level a drift of twenty-six inches. We are travelling very slowly. Found a very comfortable camp on Soft-bed creek. Made eleven miles.

December 28.—Started at 10 a. m. Cloudy and cold day. We have been threatened all day long with a snow-storm, but it cleared off towards evening, though turning very cold. The depth of snow to-day is fast decreasing; at our camping place on Big Prickly Pear creek we found only three inches. Made thirteen and five-tenths miles.

December 29.—Remained in camp, which is about two and a half miles from the top of the divide. A heavy wind-storm, with driving snow, prevailed until noon, when the snow stopped falling. One of the men went out to examine the condition of the road, and reports little snow on both sides of the divide, but a deep snow-drift on its top with a crust strong enough to bear a man.

December 30.—Started 10.15 a. m. Wind strong, with snow. The snow towards the divide is fifteen inches deep. On the divide was a drift of eighty yards in length and five or six feet in depth, the crust being able to bear a man, but our horses sink through and have hard work. On the west side of the divide I found only six inches of snow, with occasional drifts of the same depth. Down the cañon of the north fork of the Little Blackfoot river, near the junction of the north and south fork, we struck a well-beaten trail leading towards the [illegible] Hell Gate Pass, which is a very fortunate circumstance, and relieves our animals considerably. We camped on the highest Little Blackfoot crossing, known as Belknap's camp. Made fifteen and five-tenths miles. The Little Blackfoot is frozen at this place, but higher up the ice is broken by the falling of the water.

December 31.—Started 10.30 a. m. Clear and cold day, the snow being from six to eight inches deep; the beaten trail helped us along beautifully. Found both the lower Blackfoot crossings frozen over; at camp the snow was from four to five inches deep. Made fourteen and five-tenths miles, and camped one mile above John Grant's cabin.

January 1, 1860.—Remained in camp to give a rest to the animals. Warm and cloudy day.

January 2.—Started 9.15 a. m. Cloudy and warm; from the highest Hell Gate river crossing, frozen over three miles lower down. I recrossed the river and kept on its right bank for ten miles and joined the party only at Adams's corral, and encamped on Flint creek, having made twenty and one-fourth miles. Flint creek had partly overflowed its valley, covering it with a sheet of ice. Snow from four to five inches deep.

January 3.—Started 10 a. m. Cloudy and very warm day; the trail in some places was entirely covered over with snow, which at points was drifted to a considerable depth. Made the twelfth crossing on the ice, and avoided the tenth and eleventh by passing the rocky point at the water's edge. Found the ninth crossing partly frozen over but too deep to ford; and it being too late to take to the high-water trail, we encamped at the river bank in thirteen inches of snow, having made nineteen miles. Towards evening a wet snow commenced to fall; we feared that it might turn to rain. Heavy snow-drifts forced us to make a detour.

January 4.—Started at 9.15 a. m. Clear and cold. The water has fallen during the night, and we made the ninth crossing, after having removed the ice. The eighth was frozen over, but the ice cover was overflowed by fifteen inches of water. All the rest of the crossings, with the exception of the two lower ones, were frozen over; but we found, in following the beaten trail, that most of the regular crossing points had been avoided, and even the road, for some time, located over the high-water trail. At 11.15 a. m. it began to snow heavily, and continued so until evening. The Big Blackfoot river was crossed on the ice, but higher up than the usual crossing and near the foot of the plateau. We camped on White Thorn creek, having made twenty-three and five-tenths miles. It ceased snowing at 8 p. m., but recommenced at 10 p. m., and fell to the depth of six inches.

January 5.—Started 10.15 a. m. It had been snowing all night, and we started in a snow-storm. I received last night, by the Pend d'Oreille chief Alexandre, the first information that you and your party were obliged to build winter quarters on the St. Regis Borgia river. The trail was much blinded, and it still continued to snow heavily. I crossed Hell Gate river for the last time at the right of the cañon and above Rattlesnake creek on the ice. It cleared off at 12.15 p. m., but soon commenced to snow. We found the lower crossing of the Bitter Root river open for six feet on the easterly side. Made sixteen miles, and encamped on the Lo-Lo Fork.

January 6.—Started 9 a. m. It had been snowing all night, and it blows now strongly from the south, with a heavy snow-storm. The trail is entirely filled up with new snow. We found the Upper Bitter Root crossing open. Reached Fort Owen at 1.30 p. m., having made sixteen miles. My animals were all in poor condition, and the depth of snow in the valley promised them but a scanty chance for food; but I trusted that after a week's rest I should be enabled to start with some of them for your camp. With regard to my trip, I am sorry to say that I had not been able to carry out fully your instructions.

The intense cold prevented me from running a compass line, and the depth of the snow obliged me to abandon the wagon in order to save my animals. I only received your later orders to examine the road, *via* "Lewis and Clarke's Pass" and the Big Blackfoot river, on my return to this place. By information from several persons, I have learned that as yet the unexplored roads lead towards the headwaters of the Big Blackfoot river, and that both could be made practicable for wagons with but little work.

The first one leaves the Hell Gate river one and a half mile above the mouth of the Big Blackfoot river, and, striking over toward the Cammass prairie, keeps along its edge and gains the Big Blackfoot valley at a point below Lander's Fork. This road, which is certainly the shortest, would avoid all the Hell Gate crossings, and, as it is stated, offers only one difficulty, which consists in the first ascent after leaving Hell Gate river.

The second road leaves the Hell Gate valley at Flint creek, the ascent of the bordering ridge requiring some work; but it is by far not as steep as the one by the lower road; and, as my informant assures me, only a little side-hill work on a few places and the occasional cutting of a few trees would render the route practicable for a wagon road.

Very respectfully, your obedient servant,

P. M. ENGEL, *Topographer.*

Lieutenant JOHN MULLAN,
United States Army, Commanding Military Road
Expedition from Fort Walla-Walla to Fort Benton.

WASHINGTON, *February* 10, 1863.

DEAR SIR: On the 25th of June, 1860, when the expedition had arrived at Brown's farm, in the Hell Gate Ronde, you directed Mr. Howard and myself to make an examination of the Big Blackfoot trail.

The day following, we started, making first a preliminary reconnoissance as far as the plains on the eastern slope of the Rocky Mountains; returned and commenced the survey on July 5, at the junction of the Big Blackfoot with the Hell Gate river.

Mr. Howard, with three assistants, was charged to test the practicability of this route across the Rocky Mountains for the construction of a railroad, while I, with one assistant, was to make the topographical survey.

As the former failed to render his report, I will here incorporate a description of the physical condition of that part of the country, as much at least as I know of its adaptation for a railroad route.

The junction of the two rivers, our starting point, is in quite an extensive flat, 3,324 feet above the level of sea; it is surrounded by steep mountain spurs of some 2,000 feet height.

The present Indian trail, which we followed throughout, keeps all the way on the right bank of the Big Blackfoot river. Immediately after leaving the flat, near the junction, we entered a somewhat difficult cañon, nearly twenty miles in extent. We crossed a number of small creeks, with rapid currents, and had to climb over several rocky spurs from 300 to 600 feet in height, whose steep, almost perpendicular, faces are washed by the waters of the river.

Mr. Howard was of opinion that the best location for a railroad in this cañon would be on the narrow strips of level ground intervening between the steep projecting spurs, although, by doing this, the construction of nine bridges would be requisite. At the crossing places the river is less than 250 feet wide, and has very good solid banks.

The next thirty-eight miles, we passed over open, slightly undulating ground, intersected by many streams, of which three have quite a respectable size, and would be somewhat difficult to cross at the time of high water. The bottoms of these creeks are mostly fertile, and it is altogether a region very favorable for settlement. Its elevation is 3,800 feet above the sea. Over this section a railroad could be built at an ordinary expense.

From this opening we got into another cañon, of some ten miles in length, much less difficult than the first one. The mountain spurs, although of the same height, are not rocky, and do not approach the river as closely; at least, there is almost everywhere a narrow bench between the face of the spur and the river. A railroad could keep on the northern bank of the river without involving heavy work.

From the upper end of this cañon to the summit of the Rocky Mountains, a distance of twenty-two miles, the country is very easy. As far as the fork of the trails, where one leads up to Lewis and Clark's, and the other to Cadotte's Pass, within twelve miles from the dividing ridge, we passed through quite an extensive valley, with plenty of wood and water, and a good deal of fertile soil; yet, on account of its elevation, (4,800 feet above the ocean,) this valley will hardly be fit for agricultural purposes.

From the fork of the trails, where also two branches of the river join, Mr. Howard commenced a level line, which he continued across the Rocky Mountain divide, *via* Cadotte's Pass, to the Dearborn river, on the eastern foot of the mountains.

The traveller, on foot or on horseback, can hardly reconcile himself to the idea that he is approaching the crest of the mountains, so smooth and easy is the road, so gentle the appearance of the mountains around him. In July and August not a snow-capped peak is visible far or near. After crossing the river the last time, which there, of course, is but a mere rill, and ascending gradually a couple of hundred feet, he finds himself in view of the immense plains of the Missouri.

The first descent into the opposite valley is somewhat steeper, and amounts to over a thousand feet in a distance of a mile and a quarter, but thence the trail leads along the left bank of Cadotte's Pass creek on a nice bench, with hardly any obstructions.

Five miles from the summit the mountains ceased, and travelling seven miles more through the prairie, we struck the Dearborn river at a point where there is a very good ford.

Mr. Howard found the following elevations:

Fork of the trails, 4,840 feet.
Western foot of the divide, 5,653 feet; relative distance, 12.2 miles.
Summit of the divide, 6,167 feet; relative distance, 0.4 mile.
Eastern foot of the divide, 4,940 feet; relative distance, 1.3 mile.
Crossing of the Dearborn river, 4,148 feet; relative distance, 10.7 miles.

This develops the important fact that the eastern foot of the divide is 713 feet lower than the western, which presents a serious, but not insurmountable, obstacle to the construction of a railroad.

From the western foot downward, following the course of the Big Blackfoot river, the steepest grade is 217 feet for only one mile, and that the first mile, which might be overcome with or without a cut; but in order to make up for the difference of 713 feet on the eastern foot, the road would have to be carried along the side of the mountain spurs. In that case, the tunnel required would be but a very short one, say 2,000 feet.

But in order to decide whether it is cheaper to lead the road up high and cut a short tunnel, or let it run lower and make a larger tunnel, more specific investigations will have to be made.

To gain the wagon-road crossing of the Dearborn, we followed down the right bank of the river for 8½ miles, and joined there the main train of the expedition on July 26.

The map of the Blackfoot trail, with the adjoining country, which I have carefully prepared on a scale of $\frac{1}{300000}$, will give all the information which I have collected, but was unable to impart in this short report.

I am, very respectfully, your obedient servant,
THEODORE KOLECKI, *Topographer.*

Captain JOHN MULLAN
2d Artillery, Commanding Expedition.

CAMP AT NEW FORT WALLA-WALLA,
October 12, 1861.

SIR: In compliance with your instructions, the following report of an exploration for a line for a road from the Cœur d'Aléne mission to the outlet of the Cœur d'Aléne lake, and thence to Antoine Plant's, on the Cœur d'Aléne prairie, at the crossing of the Spokane river, and of a reconnoissance from Antoine Plant's, *via* what is known as Mix and Russel's road, to Snake river, is respectfully submitted for your consideration.

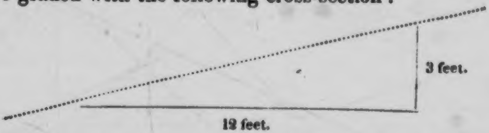
In obedience to your verbal instructions of the 13th September, I left the mission on the morning of the 14th, and proceeded as far as the Wolf's Lodge prairie, which is the first camp-ground from the mission on the line of the Spokane trail. The Wolf's Lodge is a prairie a half mile in length and a quarter mile in width, with a fine, clear stream, fifteen feet wide and two deep, flowing through the eastern and northern portion of it. The stream is lined with willows, the prairie is covered with excellent grass, and is enclosed by mountain spurs covered with open pine timber; its distance from the mission by the trail is about 18 miles. Here I camped, and on the morning of the 15th started with "Bazil," my Indian guide, to examine on foot the line from the prairie to the mission.

As it is impracticable to follow the line of the trail, leading, as it does, over high, steep side-hills, rock in many places covered with fallen timber, and also making ascents and descents so steep as to be unsafe even for a rider, the only way in which a road can be had is by following the lines of the water-courses in the valleys below the trail, and work such places in side-hill excavation as are rendered otherwise impassable for a wagon road.

After leaving the trail at the east end of the Wolf's Lodge, where it first takes the side-hill, we passed through pine and fir timber for a hundred yards, when we entered a small prairie 200 feet in diameter, after passing which there are no more prairie openings. We followed near the foot of the hill to the north, and for the first mile and a quarter passed through pine and fir timber of the size usually seen in the wooded country on the mountains near the mission, the trees being from 80 to 150 feet in height and from 8 to 20 inches in diameter. There is an old Indian trail for part of this distance. We then turned to the north, crossed a dry water run, and ascended along the backbone of a spur for a quarter of a mile to a saddle about 200 feet in height, the ground being strewn with fallen timber, which covered the ground in every direction, rendering our progress slow and laborious. In 900 feet more made the descent from this saddle, which is somewhat steep on the eastern slope, but will not require doubling teams. After reaching the foot of this saddle, which I will designate as No. 1, the line for the next mile and a half turns more to the north and follows up the narrow valley of a small stream, crossing from time to time, as may be necessary; the bed of this stream is of hard gravel. 1,000 feet of light side-hill grading will have to be done to pass through a narrow defile made by the passage of the stream through a spur of the mountain, and for a quarter of a mile more granite boulders, from one to two feet diameter, will have to be removed, to allow the easy passage of wagons. The line strikes the trail about one mile east of saddle No. 1, and follows its general course for a half mile, when it leaves it to the north and ascends an open ravine, narrow at the bottom and very much obstructed with fallen timber. This ravine leads to saddle No. 2 by a good ascent of a quarter of a mile in length, elevation about 200 feet above base. The descent to the east is steep and will have to be modified by grading, unless a natural descent be found on the spurs leading to the south. After descending from saddle No. 2 a valley is reached in the bottom of a steep ravine, along which the road will pass for a half mile, when it will ascend to a third saddle, which will be reached by a long and not very steep ascent of 300 feet in height. This distance of 5½ miles is difficult, the ground being covered with fallen timber, which is crossed and tumbled down in every direction, rendering progress exceedingly difficult. The ascents and descents to these three saddles are steep, however, not sufficiently so as to require double teaming. It will hardly be possible to find any practicable line other than the one explored, as the ridges of the mountains extend in a direction parallel with the course travelled, and rise to a height of from 1,000 to 2,000 feet.

Between the first and second saddles there are two or three streams, which come from the mountains, and are crossed near their mouths by the line of the road location. The ground is hard and solid, being composed of gravel and vegetable mould, and the streams never are of sufficient size to render them impassable by fording, and in the fall are nearly dry.

Descending from the third saddle by a very good slope to the valley 250 feet below, we reach that portion of the line which is most difficult, and will cost much labor in the process of construction. In the first mile 1,400 feet in length will have to be graded with the following cross-section:



This brings us to the first cañon, where the stream flowing from No. 3 enters a cañon, which is from 25 to 50 feet in width, bounded by perpendicular rock, in many places from 20 to 30 feet in height. Here for one mile the road will have to be cut in earth and rock excavation along the side of a spur having a transverse slope of 40°. Advantage can be taken of the formation of the ground, so as to avoid any very severe work, except for short distances. After passing this we can again descend to the valley of the stream, follow on its left bank for 200 yards, when we cross a small tributary from the north and come to the second cañon, similar in its characteristics to the first. The stream winds through it with a narrow alder bottom alternately forming the banks, as the creek turns from side to side in its descent. This cañon is 2½ miles in length, and will be avoided by side-hill excavation for that distance. The work on this section will be severe, and if the rock proves to be hard, when reached, may have to be worked out by blasting. It outcrops in many places, especially on the points of the spurs; has a transverse slope of from 20° to 30° and in some places 45°.

After passing the second cañon the ravine opens out by the receding of the mountain spurs, and a cedar swamp begins, which continues for 3½ miles. The spring can only determine whether it will be best to locate the road through this, which has heretofore proved to be objectionable ground, although at the time when I passed over it it was good and dry. The huge cedars, from three to eight feet in diameter, tower above the ground, and their interlaced branches hardly admit the sun's rays. If the ground is found hard in the spring, but little work will be required to pass through, as the trees grow sufficiently wide apart to allow the passage of a wagon conveniently. We crossed two large watercourses with gravel bottoms, now dry, which were about four feet deep and 25 wide. A more detailed examination may show that a line may be had by keeping around the foot of the spurs, and, by doing occasional grading at points where required, avoid this long stretch of ground, which is probably soft and miry. Leaving this cedar swamp we struck good ground, covered with pine and fir timber, and clambered over and between fallen trees for a quarter of a mile, when we reached a spur with a stream at its base. Here a crossing may be made, but it would be best to grade 300 feet around it, and then continue for nearly a mile over the same kind of ground to a second spur, around the base of which the line would be graded for 1,000 feet—transverse slope 5 on 10. Here the line leaves its general SE. course and deflects towards the east for a short distance, when it again resumes its general direction. At the point of this spur we leave the valley of the main creek and follow up a small tributary, to shorten distance. I will here note a small cone, 50 feet high, which forms a landmark, and around the western base of which the line passes. In a mile more we ascended by a very easy grade to a low saddle or ridge, then descended as easily to the east, and after passing over good ground, in 1¾ mile reached the open prairie, 1½ mile from the mission.

I regret that I could not make this examination as thoroughly as desired. My guide, the Indian "Bazil," had recently broken his collar-bone, and the fracture was not even dressed, so that he was unable to carry our blankets and provisions. This work, therefore, devolved upon myself, in addition to other duties, and it was not possible for me, thus encumbered, to examine in person the country in the vicinity of the line. The only place requiring further exploration is the distance of 3½ miles around the cedar swamp at the base of the spurs.

I estimate that 18 days' work of 50 men will be required to cut and clear the road from the Mission prairie to the Wolf's Lodge; and for the grading, if the rock proves compact in the side-hill work referred to, a month or even six weeks would not be too large an allowance for the time which 50 men would occupy in working it, there being at least 4½ miles of grading required to avoid the two cañons of the creek and other points noted in the foregoing. The distance is estimated by the line travelled at 17 miles. Having finished this portion of the exploration, I returned to the Wolf's Lodge, and on the 21st proceeded to examine the line to the outlet of Cœur d'Aléne lake. For the first two miles and three-quarters the line would follow the general direction of the trail by taking advantage of the ravines to the south to gain the ascent of 300 feet to a saddle, which is a mile and three-fourths west of the Wolf's Lodge. A good descent can be found from this saddle to the valley of a small creek in a mile more, although it will have two or three steep grades in that distance.

After crossing this stream, which flows through a valley of nearly a quarter of a mile in width, the trail winds up the steep side of a mountain which is not far from 500 feet in height, and impracticable at that point as an ascent for a road. After gaining this elevation the ground is nearly level for the next three and a quarter miles, with the exception of three ravines which are crossed by the trail.

The first is a mile and three-fourths from the creek, and is broad and level, being 300 feet wide. This will be subsequently referred to as the third ravine. The other two occur in one-half and three-quarters mile further on; are steep and narrow, coming to a point at the bottom; are about fifty feet deep, and present a serious obstacle to the passage of a road without resorting to heavy bridging on tressel-work. The descent to the lake shore is made by a steep pitch of 450 feet in height. The trail winds and turns along the face of the spur to make this the last descent.

Having heard of Antoine Plant as a man who, from his long residence in this neighborhood, was well acquainted with the mountains and trails leading through them, I deemed it best to proceed to his residence and procure his services as guide, and examine a line of which the Indians have spoken, leading direct from the Wolf's Lodge to the lake, and giving good ascents and descents in place of the steep pitches which occur by the line of the trail. I accordingly proceeded over level prairie, covered with open timber, to the outlet of the Cœur d'Aléne lake, distant four miles from the foot of the mountain, and followed down the Spokane river on the line of the trail for six miles, where we encamped and remained a day to examine the Little Falls of the Spokane river. Having finished this examination I started on the 23d, and just below the Little Falls left the open pine timber through which I had travelled since leaving the Wolf's Lodge, and entered upon the Cœur d'Aléne prairie, which stretched a level plain as far as the eye could reach to the northeast, towards the Pend d'Oreille. It is bounded by ranges of mountains, which, with their spurs timbered from base to summit, form a pleasing contrast to the prairie, covered with its dry and browned grass. The Spokane river flows through the southern end of the prairie in a channel some thirty or forty feet below the general level of the plain. The soil is gravelly, and not suited for farming purposes, until you cross the Spokane, after which, as informed by Antoine Plant, the soil is fertile. After travelling nine miles across the prairie we reached the foot of the mountains on the west, along which we proceeded for three miles, when we arrived at Antoine Plant's.

On the 24th I started with Antoine to complete the examination of the line from the lake to the Wolf's Lodge. We followed the trail as far as the mouth of the Cœur d'Aléne lake, and then struck to the east through the open timber for four miles, until we were stopped by a lake one mile in length and one-half a mile wide, whose existence was not before known. This lake is enclosed on its northern, southern, and eastern sides by high, steeply-sloping, rocky, mountain spurs, which forbid the passage of a road or any other line than that in the vicinity of the trail.

Having satisfied ourselves of this, we followed down the western side of the lake, and in one-fourth of a mile reached the shores of the lake, where we encamped, and, on the morning of the 25th, proceeded to examine a ravine which leaves the trail to the south and affords an ascent (somewhat steep in places) of one and a half mile in length to the summit of the last mountain over which the trail passes before reaching the lake. The ascent in this distance is not far from 1,000 feet, and will afford a road without any very heavy work, but one which will require double teaming to make the ascent. The descent to the east to the third ravine is naturally good, but to improve it may require 300 feet of light side-hill grading in earth. The ascent of 50 feet to the plateau to the east of this ravine can be made by side-hill grading for 300 feet, if a natural ascent cannot be found on further exploration. Three hundred feet from the top of this plateau we again left the trail and struck the head of a ravine of one and a half mile, down which we followed to the valley of the creek, entirely avoiding the steep grade previously referred to. This ravine is cañon-like in many places; its bottom is covered with a growth of generally small fir trees, and is somewhat obstructed by fallen timber. It is only wide enough to allow the comfortable passage of a wagon in many places, say fifteen to twenty feet wide. This is the only ravine which can be taken advantage of to make this descent; and if it is not made use of, side-hill excavation, part in rock, must be resorted to for at least a mile to make a practicable grade. The ravine debouches a few yards from the trail on the north. After crossing the creek the ground is less difficult, and the only obstacles are those previously noted.

Antoine Plant informed me that the snow disappeared from these mountains in May, there being perhaps a little left in deep ravines protected from the sun. Its average depth during midwinter is not to exceed two feet. On the Cœur d'Aléne prairie there is but little or no snow, the Indians always resorting to it as a common wintering ground for their horses and cattle.

The line explored from the lake to the third ravine is objectionable on account of its steep grades, but this can only be obviated by one and one-third mile of heavy grading along the face of the mountain around the shore of the lake to the third ravine, where it can then be located for the remainder of the distance to the Wolf's Lodge by following the line of the trail as before described.

I am, sir, very respectfully, your obedient servant,

W. W. JOHNSON,
Civil Engineer.

Lieutenant JOHN MULLAN, *U. S. Army,*
In charge Fort Walla-Walla and Fort Benton Mil. Road Expedition.

[Extract from Stevens's Report.]

RAILROAD REPORT AND ESTIMATE—FROM THE MISSISSIPPI TO THE COLUMBIA, *VIA* THE NORTHERN ROUTE

St. Paul to Bois de Sioux—Bois de Sioux to Fort Union—Fort Union to crossing of Milk river—Crossing of Milk river to Fort Benton—Fort Benton to entrance to tunnel, Cadotte's Pass—Hell's Gate crossing, *via* Clark's Fork, to the Spokane—Hell's Gate crossing to crossing of Bitter Root—Crossing of Bitter Root to entrance to tunnel, through the Cœur d'Aléne mountains—Tunnel at Stevens's Pass of the Cœur d'Aléne mountains—Tunnel to the Cœur d'Aléne mission—Cœur d'Aléne mission to crossing of the Columbia—Crossing of the Columbia to Seattle, Puget Sound—To Vancouver, on the Columbia, and thence to Puget Sound—Estimate of cost.

ST. PAUL TO BOIS DE SIOUX, (MINNESOTA.)

The Mississippi, at St. Paul, flows some hundred and fifty feet below the higher prairie east of the town. The ascent to this plateau is made with a forty foot grade; then, with little variation of surface or soil, the line follows the general direction of the river, passing over prairies or oak openings to Sauk Rapids, and thence to Little Falls, 112 miles. The same characteristics obtain to Crow Wing.

In this interval the soil generally consists of a vegetable mould, of from one to four feet in depth, resting on a gravelly or sandy substratum, affording the best material for a fine and dry-road embankment. On the right, and further towards the interior, is the heavily wooded and timbered country of Minnesota. No rock cutting was observed, though rock was found near St. Anthony's Falls, and in the vicinity of Sauk Rapids. The grades are light, seldom exceeding two feet per mile. The bridge crossings are, at Rice creek, 60 feet; Cow creek, 60 feet; Rum river, 150 feet; Elk river, 120 feet. The culvert masonry is small, and the earthwork will not exceed an average embankment of six feet. For structures, both of wood and stone, the material is good and near at hand. The crossing at Little Falls requires but 325 feet of bridge, in two stretches, the river being divided by an island. The river is crossed at right angles; the abutment rests on a rock, and being at the falls, the bridge presents no obstruction to navigation. Here the crossing affords a good connexion with a line from Lake Superior, and on the west side enters a better wooded country than that further south, and one probably adapted for a firmer and drier road-bed.

Crow-Wing has also great advantages for a connexion with Lake Superior, in the facility with which a bridge can be thrown across the river at that point, and the easy and very fertile character of the country, both eastward to Lake Superior, and westward to the Bois de Sioux, in its inexhaustible timber, and in the saving of distance in the crossings to the south. The crossings at St. Anthony's Falls and Sauk Rapids are, respectively, of 800 and 600 feet, both feasible, and giving fair facilities.

In the next hundred and twenty-eight miles, to the Bois de Sioux prairie, the line passes successively through wooded and prairie country, the rise in this interval being about three hundred feet, the ground rolling, sometimes showing stony and gravelly knolls, and frequently interrupted by small lakes. The earthwork in this portion will not exceed an average embankment of eight feet high, and is occasionally stony. Granite boulders, at occasional intervals, are scattered over the surface. Side ditching is often necessary in flat and low places, but for the main part of the distance the excavation is high and gravelly. There is no rock excavation. Grades of thirty feet per mile will occasionally be required in the limited region of knolly, rolling country, but will not generally exceed ten feet. Crossing the tributaries of the Minnesota at their sources, the amount of bridging will be small; an estimate of two hundred feet on the small streams of the Crow, South Branch, and Chippewa rivers covers the whole. The culverts will be frequent, but small. The pine and wooded region is estimated to extend on this line eighty miles westward from the Mississippi. From this the supplies of timber will be mostly drawn.

Stone is found in places only at the Mississippi. Granite boulders which will supply culvert masonry are found some sixty miles west of the Mississippi. For the small amounts of bridge abutments stone must be brought from the Mississippi unless good materials are hereafter found more convenient.

The Bois de Sioux will require a bridge of one hundred and forty feet; thence forward to the Missouri the distance is 426.7 miles, and the total rise is about seven hundred feet. The first part of this is over the plateau of the Bois de Sioux.

BOIS DE SIOUX TO FORT UNION.

The line westward from the Bois de Sioux passes south of the Shyenne and avoids the difficult crossings of that river. In the breaking up of the winter, and with the spring rains, the plateau of the Bois de Sioux is undoubtedly very wet and marshy, and to a great extent covered by a small depth of standing water. The Wild Rice river, and a branch of it which also runs through this plain, will require bridges of one hundred and twenty and one hundred feet. From south of the Shyenne to Mouse river the country is nearly uniform, gradually rising, in part undulating, but frequently marshy, and with many small lakes. James river is crossed by a bridge one hundred and twenty feet in length. There is a general destitution of wood throughout this interval. The Bois de Sioux and Wild Rice rivers will furnish a small amount, and the Shyenne will supply sleepers for two hundred miles of the way—single track. We do not know that James river will furnish any, but wooded lakes occasionally aid in the supply. A supply can be procured from Miniwakan lake. Mouse river is a large stream of water, and, after the Red River of the North, the most important on the route between the Mississippi and the Missouri. It flows in a deep, wide valley, upwards of two hundred feet below the prairie level, the bottom varying from a half mile to two miles; it is wooded, sometimes heavily, with elm, oak, ash, maple, &c. Its high and steep banks are cut up by deep coulées extending back for fifteen or twenty miles. As these coulées would be difficult to cross, the railroad line is located so as to head them. At Mouse river a coarse grey sandstone crops out, and near by, at the Maison du Chien, Mr. Lander reports an abundance of excellent building sandstone. Mouse river is one hundred and twenty feet wide, and apparently as much as seven feet deep. The information collected as to its navigability was, from one source, that there was no obstruction; from another, that one rapid existed in the course down to its junction with Red river. This may be of great service in transporting materials, besides affording access to its beautiful and fertile valley.

Between Mouse river and Fort Union the route crossed the plateau du Côteau du Missouri, and though by keeping up the River of Lakes to its source a somewhat more level and uniform surface is found, with grades not exceeding forty feet per mile.

The grading on this route will not exceed fifty feet. The line should strike some point on the Missouri in the vicinity of the mouth of the Yellowstone, at the head of navigation for the large class of steamers which can run down the Missouri. This point will be in the general vicinity of Fort Union, and can be reached by the valley of the Little Muddy.

At Mouse, Shyenne, Bois de Sioux, and Wild Rice rivers, but best at Red river, all the materials for good bricks are obtained; and it may be found cheaper and better to use brick masonry in the neighboring bridges and culverts, though the granite boulders will supply a considerable amount. Water can, by reservoir and unimportant aqueducts, be introduced at any point desired, and the numerous small lakes along the route will in this way be of service. Even through salt water regions, fresh water ponds are more numerous than those that are brackish. Prairie fires should be provided for by ditching; and as the grass is not generally heavy, this will prevent all danger to the wood work and trains. Besides the supply of wood on the rivers and on the Missouri, the road will require supplies to be transported from the forest near the upper Mississippi. But without this it is estimated that the supply along the line is sufficient for six years.

Coal exists in lower Minnesota and Iowa, and an inferior quality was also found on Mouse river.

FORT UNION TO CROSSING OF MILK RIVER.

From Fort Union the line follows up the favorable valley of the Missouri to Milk river, $105\frac{3}{10}$ miles, and then up the equally fine valley of the Milk river for 180 miles further. The bottom lands of both are composed of clay and sand, of a nature to become soft and muddy in wet weather, but parched and cracked during the dry season. This section does not offer the best, but will afford a fair, material for road embankment.

The tributary rivers on the north side for which bridges must be erected are, the Great Muddy, Poplar, and Porcupine, all small streams, with an average width of 60 feet; the greatest depth where crossed, three feet. They will each require eighty feet trusses, with two abutments.

There is, besides, one peculiar feature for which provision must be made in constructing a railroad. At short intervals, not over eight miles for the whole river line, narrow, canal-like channels are found, generally extending from the coulées of the bluffs, dry in summer, but in the spring freshets forming the sluices by which the surplus water runs into the river. These have an average width of 25 feet, with a depth of eight feet, and should be spanned with a single timber structure, to prevent the accumulation of water, which would take place if the embankment was filled in across them, and which would in time undermine it. Missouri river, in the vicinity of Fort Union, is about 450 yards wide, and up to Milk river has a valley from two to eight miles wide. Its banks are well wooded with cottonwood, and have a small quantity of red cedar.

The hills on the south side are rough, broken bluffs, from 300 to 500 feet high; and on the north side they also rise abruptly, but are low, the plain, a few miles back, being only from 100 to 300 feet above the river. A coarse, white sandstone crops out of the bluffs, but apparently will not be used for building. Here the Yellowstone coming in, will aid in supplying timber, and perhaps stone, from the Black Hills and other ranges wooded with pine, which occur some distance up, near its source. The lignite of this region, traced from the coulées of Mouse river to the headwaters of Milk, a distance of 500 miles, apparently underlies this whole district, in a bed varying from a few inches to six feet thick, and is a source of fuel not to be overlooked. Lime and sand are both to be obtained, and good materials for brick exist. In summer there is a scarcity of water, the small streams being dried up; but from the elevation of the plateau above the valley, a good means is afforded of keeping up a supply, with the assistance of reservoirs, in those places at a distance from the main stream.

The rise in level along the Missouri is about one foot, and on Milk river about three feet, per mile only.

The cottonwood of the Missouri will answer temporarily for railroad sleepers. The stockade built of it at Fort Union, which does not rest on the ground, is firm and sound, though built over 25 years ago. Milk river is crossed in a bend of the stream, at right angles to the current, requiring a truss of about 240 feet, with an abutment 20 feet above the river bottom. The masonry should be protected by piling from the wash of the freshets.

CROSSING OF MILK RIVER TO FORT BENTON.

Milk river is crossed about two miles below the mouth of Box Elder creek, and the line passes up its general valley about thirty miles, when a choice of routes may be made. One route passes up a wooded tributary of the Box Elder, thence over a low divide to the Missouri, and follows up the Missouri, on its northern bank, to Fort Benton. The other ascends the plateau between the Box Elder and the Marias, passes near the spring, descends into the valley of the Marias, near the junction, with the Téton, continues up the Téton to the point where it approaches within one hundred yards of the Missouri, then passes to the valley of the Missouri, and continues on the route before referred to, to Fort Benton. The distance by the first route is eighty-one and one-half miles, and by the second, seventy-five and five-tenths miles. The grades up to Box Elder will range from ten to twenty feet. The excavations and embankments will be quite moderate. The several streams, which are from five to ten miles apart, will require bridges of from fifty to seventy-five feet in length. There are also coulées which will require some culvert work. The valley of the Missouri should be struck at the mouth of the stream which flows from the springs; the distance from Box Elder creek to this point being twenty-one miles. About five miles from this point will be the summit of the divide, which, allowing for a cut of fifty feet, will have an elevation of 2,832.2 feet.

The altitude of the Missouri is 2,558.5 feet, requiring a grade to meet the Missouri of 54.74 feet to the mile. From the Box Elder to the summit the grade will vary from 45.6 feet to 48.2 feet per mile. Most of this distance is a gently rolling plateau, requiring but little excavations and embankments; but the first four miles from the Box Elder the grade will be 45.65 feet to the mile, with some heavy work. From the mouth of the creek to Fort Benton, a distance of thirty and one-half miles, the grades will be very gentle, not exceeding ten feet to the mile; the whole rise being but 221 feet. In that distance, to avoid sharp curvature, say less than two thousand feet radius, there will be heavy excavations in turning the points which project into the river. The river is wide, and will render it perfectly easy to waste earth without interfering with the channel of the river.

The altitude of Milk river is 2,388.8 feet, and of the Box Elder, at the point where the route leaves it, 2,691.7 feet. The other line referred to, passing over the plateau, in four miles makes a height of 2,924.3 feet, when it continues over a gently rolling prairie for twenty-six miles to the point where the descent commences to the valley of the Marias, the highest point being in the vicinity of the springs, and having an altitude of 2,982.2 feet. The descent to the Marias involves difficult and costly work, and must be made in one and a half miles along the foot-hills, and up the stream, which should be crossed by a bridge one hun-

and feet high, at an altitude of 2,782.9 feet, the altitude of the point whence the descent commences being 2,865.1 feet. The route then continues up the Téton nine and a half miles to the Cracon du Nez, with a descending grade of 31.7 feet to the mile. The bluffs of the two sides of the Cracon du Nez are about one hundred yards apart, the foot of the bluff in the Téton being 81.5 feet above the foot of the bluff on the Missouri. By commencing a cut, however, before reaching the bluffs, we reach the valley, and commence going up the Missouri with an embankment about forty-one feet above the immediate line of the river, but which can be very much reduced by being adjusted along some foot-slopes that line the valley. The descent can be made to the valley by a grade not exceeding forty feet to the mile, without heavy excavations or embankments. By either of these routes there will be no difficulty about supplies of water. The Box Elder, its several tributaries, the Missouri, the Marias, and the Téton, will furnish an unfailing supply. The longest distance without water will be on the plateau route, viz: from the Box Elder to the Marias, a distance of 31.5 miles; it is probable, however, that water can be obtained by sinking wells near the springs. Either route can be easily supplied with all the materials for construction. The Bear's Paw, near by, as well as the country south of the Missouri, will furnish timber of all kinds. There is good limestone and sandstone in the vicinity of the route; sand for mortar, and clay for bricks.

FORT BENTON TO ENTRANCE TO TUNNEL—CADOTTE'S PASS.

Cadotte's Pass, at the head of the Big Blackfoot, may be reached from Fort Benton, either by keeping up the valley of the Missouri to the mouth of Sun river, thence up the Sun to a point nearly opposite the Rattlers, thence crossing the Sun between Crown Butte and the Rattlers, and continuing nearly on the course pursued by the wagon road, or the crossing of the Sun may be made by ascending the plateau from Fort Benton, and passing by the springs and Prairie lake, referred to in the itinerary. The distance by this latter route, from Fort Benton to the entrance to the tunnel of Cadotte's Pass, will be one hundred and two and two-tenths miles. This is four miles longer than the trail pursued in 1853, for I have allowed two miles to make the descent into and the crossing of Sun river, and two miles for that of the Dearborn. The distance from Fort Benton to the crossing of Sun river will be fifty-five and one half miles; thence to the Dearborn, thirty-six and seven-tenths miles; thence to the entrance to the tunnel, ten miles. From Fort Benton to the springs the distance is sixteen and one-fourth miles, to the lake, eighteen and one-half miles, and thence to the Sun river, twenty and three-fourths miles.

There will be no difficulty in adjusting grades over this distance not exceeding forty feet to the mile. The highest summit, at a distance this side of the Prairie lake of seven and three-quarter miles, is three thousand eight hundred and thirty-six feet above the level of the sea. There is a summit five and a half miles beyond the Prairie lake, whose altitude is 3,702 feet above the sea. The altitude of the Prairie lake is three thousand five hundred and fifty-eight feet. To adjust, however, a grade of forty feet, there will have to be cuts through the several summits, and excavations and embankments throughout the route. Sun river should be crossed with a bridge fifty feet above its valley, and the descent must be made with much care by side-hill locations, for in fifteen and three-fourths miles, there will be a descent of three hundred and sixty-six feet. The Dearborn is crossed about a mile and a half above its junction, with the stream flowing from Cadotte's Pass, with a bridge seventy feet above its immediate valley, and at an elevation of four thousand three hundred and forty feet. There is a high ridge five and six-tenths miles beyond the crossing of Crown Butte creek, and twenty miles from Sun river, where a tunnel will be required half a mile in length. This ridge has an elevation of four thousand two hundred and thirty-five feet above the sea, and the summit level of the tunnel will be four thousand and seventy-two feet. The grade, on the supposition that it will be uniform from Sun river to the tunnel, will be forty-four feet per mile, but the work will be difficult, and it will not probably be found practicable to dispense with less than sixty feet grades.

From this tunnel to the Dearborn there will be a rise in the whole distance of two hundred and sixty-eight feet, giving grades, on the supposition that they are uniform, of sixteen and a half feet to the mile. From the crossing of the Dearborn to the entrance to the tunnel is a distance of ten miles, requiring grades of sixty feet to the mile. This work will be very costly and heavy, and require a very careful side-hill location. Besides heavy excavations and embankments, there will be a great number of small bridges and culverts. The eastern mouth of the tunnel will be in the debouche of a ravine, which gives a much better approach than the usually travelled trail. The tunnel will be 4.19 miles in length, when there will be a cut commencing fifty feet deep, and coming out into the valley of the Blackfoot five hundred and fifty-eight thousandths of a mile west of the tunnel. The cut and the tunnel have a grade of sixty feet to the mile. The highest point of the road, therefore, will be at the entrance of the cut, at an elevation of five thousand one hundred and ninety-five feet above the sea, and eight hundred and forty-nine below the mountain summit.

The entrance of the cut will be two and nine hundred and forty-eight thousandths miles west of the western base of the mountain, which is five hundred and sixty-seven feet higher than the eastern. This section, from Fort Benton to the entrance to the tunnel is in the near vicinity of materials for construction; there is good building stone near the crossing of the Sun and Dearborn rivers and near the Crown Butte creek. The Téton, Sun, and Dearborn rivers furnish sand and gravel as well as good cottonwood. The Missouri and the mountains in the vicinity of the pass will furnish the yellow and pitch pine. Cadotte's Pass can be reached more readily on this route than by going high up Sun river, crossing over to the Dearborn, and over the broken country lying between the Dearborn and the entrance to the pass.

The route by the Missouri to the crossing of Sun river will be easier in its grades than that over the plateau, but it will be heavier work of excavation and embankment. There are many sharp points running down to the Missouri, which must be dealt with in the same manner as the similar places which occur below Fort Benton. The distance will be sixty-three miles, or seven and a half miles further than the route over the plateau. There will be, however, advantages on the line of the Missouri in the unfailing supply of pure water, and its greater accessibility to all the materials of construction.

To reach Lewis and Clark's Pass either of these routes may be taken to Sun river, when we continue up Sun river, and its Elk or south tributary, a distance of forty-eight miles, or ten miles above the forks. The valley of the Sun river and that portion of the Elk fork is very easy for railroad construction, and the grades will vary from 43.5 feet to 50.3 feet per mile. Starting from Fort Benton we make a rise in eleven and a half, twenty-five, sixteen, twenty-two, fifteen, ten and a half miles, respectively; eighty-three, one hundred and sixteen, four hundred and ninety-five, one hundred and eighteen, one hundred and ninety-seven, three hundred and twenty-five and one tenth feet, giving the respective gradients of seven and twenty-one hundredths, four and sixty-four hundredths, thirty and nine tenths, five and thirty-five hundredths, thirteen and one tenth, thirty and nine tenths, forty-five and six tenths feet, to the mile. At the Great Falls of the Missouri, where in fifteen miles there is a fall of three hundred and fifty-seven feet, the grade must be adjusted with great care, at the expense of heavy work. For ten miles above the forks of Sun river the grade will vary from forty to fifty feet per mile; the work of excavation and embankment will be light. Thence to the tunnel of Lewis and Clark's Pass is nineteen and one hundred and twenty-one thousandths (19.121) miles, all very difficult and heavy work. The tunnel itself is two and one hundred and twenty-nine thousandths (2.129) miles in length. The summit level of the tunnel is at a debouche a half mile west of the western base of the mountain, and is 5,698.6 feet above the level of the sea. It passes out on a descending grade of sixty feet to the mile, at an elevation of 5,570.86 feet above the sea, the summit level of the mountain being 6,519.3 feet above the sea. As in Cadotte's Pass, the eastern approach is by a ravine north of the travelled trail. In ten miles above the forks the line leaves the general valley of the Elk Fork, crossing the highest summit about half-way between the route of the party of Stevens in 1855 and Hart mountain, and crosses Dearborn river at an elevation of 4,994 feet above the sea, and about one mile above the trail. The country is lower and less broken by this route than in any other part of the plateau between the upper waters of the Sun and Dearborn rivers. The Dearborn itself leaves the mountains by a gap in a direction nearly east, when it turns suddenly to the south, and continuing on three miles it runs suddenly again to the east to the point where it crosses the trail. The railroad line follows along the Dearborn in this south line three miles, and makes the crossing just below its last turn to the east. A bridge, one mile in length and nearly 300 feet above the valley, which at this point has an elevation of about 4,700 feet above the sea, will be required to cross the Dearborn. Thence for two miles and three-eighths the road will follow very nearly the natural grade, varying from forty to sixty feet to the mile. In two miles and three quarters further we come to a ravine, in which flows a stream of water which can only be turned by continuing up the ravine and keeping closely along the side-hills. Between this point and the entrance to the tunnel, a distance of 4¾ miles, there will be seven small streams to cross, involving the adjustment of a grade of sixty feet to the mile, the necessity of constant curvatures with radii of 1,500 or 2,000 feet. There will be very heavy embankments required to cross these several streams, which can, however, be made up from the adjacent spurs, with hauls exceeding in no case a half-mile; moreover, the ravine into which the tunnel debouches on the east, by the best system of side-hill approach, must be filled up, which can be done by the debris from the tunnel. The country at right angles to the line of the road rises towards the mountain at a grade of from one-fourth to one-eighth. This is equally the case with the ravines in which the streams flow and the intermediate divides. Debouching from the tunnel on the western side the line continues in the valley of the stream for five miles, at a grade of thirty-five feet, with an excavation and embankment almost entirely along the natural surface, and for a mile and a half further, at a grade of forty-four feet to the mile, when we leave the stream, and making a cut through a low divide of about 700 feet in length, come upon a gently sloping prairie, down which it can be laid, and brought into the valley of the Big Blackfoot through the open valley of a small stream, at a grade of from sixty to sixty-five feet to the mile. This grade will involve closely hugging the side-hills which line the valley of the small stream, and the Big Blackfoot on the west, and will involve a curve of the minimum radius. The greatest depth of the cut will be 134.7 feet. For the first 80 feet the cut will be from 134.7 feet to 122.6 feet in depth, and for the next 500 feet from 122.6 to 38.8 in depth, then in 100 feet the cut reduces to 31.4 in depth, and in 1,000 feet further to 20.8 feet in depth, and it runs out 200 feet further.

To resume the line down the Blackfoot from Cadotte's Pass. From the summit level at the entrance to the tunnel the line continues down the valley for six and twenty-eight thousandths miles, when it is joined by the line from Lewis and Clark's Pass. Three-fourths of a mile before reaching this point it crosses the stream flowing from the pass; continuing for four and one-fourth miles further, it crosses Lander's Fork. A considerable bridge will be required here, consisting of a single arch of two hundred feet. Excavations and embankments will average from fifteen to sixteen feet. It then continues down the valley, which has been gradually widening from the pass, for nine miles, when it reaches what is known as the cañon. In this distance two streams are crossed coming from the north. This distance is in the prairie known as the Belly. The work here will be very moderate, the excavations and embankments small. The cañon is a low, open valley, in no case less than one-third of a mile in width, and widening out two or three miles. Excavations and embankments are moderate. The country is mostly wooded. Seven miles from the entrance to the cañon we come to a prairie of one thousand acres, which is overflowed at high water, and against which special precautions will have to be made. Only one stream of any consequence is crossed—about three miles before issuing from the cañon. Leaving the cañon, we come into the Stevens prairie. At this point the Blackfoot will have to be crossed twice in a distance of a mile and a half. The distance across the prairie is thirty-four and six-tenths miles; and the line can be laid in nearly a straight course by adapting the grade to the ground, at the expense of heavy excavations and embankments. In about eight and a half miles Salmon Trout creek is crossed, requiring a bridge and careful adjustment of line. In ten and a half miles further another large stream is crossed; and in the remaining distance two or three small streams will have to be bridged; and seven miles before reaching the end of the prairie a cut must be made through a low ridge.

We have now come to the lower cañon of the Big Blackfoot. This cañon is nineteen miles long, and is perfectly practicable. The river must be crossed frequently, not, probably, less than thirteen times, and, to avoid short curvatures, there must be heavy excavations, mostly in rock. Embankments will be moderate. There will be no difficulty in wasting earth. Occasionally sustaining walls must be resorted to. In the narative reference has been made to the prairies opposite projecting points; and in locating the railroad line care must be taken to pass from prairie to prairie. In six miles further we come out of the valley of Hell's Gate into the general valley of the Bitter Root at a place known as the Hell's Gate Ronde. Here the trail crosses the Hell's Gate to Fort Owen. This point, in the estimate, has been called the crossing of Hell's Gate. In this section, of ninety-one and sixty-eight hundredths miles from the tunnel, there will be ample materials for constructions of all kinds; timber for all purposes of construction inexhaustible; ample supplies of water, gravel, and sand are found at convenient points. There are many localities of good building stone. Slate is found at the mouth of Salmon Trout creek, and limestone, suitable for walls of all kinds, in the lower cañon.

The whole descent in this distance is 1,735.8 feet, or an average grade of 18.94 feet to the mile. The several grades shown on the profile, on the supposition of uniform grades, for the several distances will vary from 63 feet to 3.1 feet to the mile. But it will be found advisable, to diminish excavations and embankments, not to use as low grades as three and one-tenth feet to the mile; though without large excavations and embankments and proper side-hill locations, there will be no necessity of rising grades greater than fifty feet to the mile. It is probable that a better line can be found by turning to the south seven miles before reaching the western end of the prairie, crossing the Big Blackfoot, passing through the extensive Camass prairie on the southern side, and returning to the immediate valley of the river six miles before reaching the end of the cañon. There will be no difficulty from freshets in this section. The prairies are not overflowed in high water, except small portions of the Belly prairie, and the greatest rise and fall of the Big Blackfoot will be about six feet.

HELL'S GATE CROSSING VIA CLARK'S FORK TO THE SPOKANE.

The route is the same with the route of Stevens of 1855 for seven and a half miles below the Hell's Gate crossing, when it follows the northern foot-slope of the Hell's Gate Ronde, and passes over the summit, which lays between it and the Flathead river, with a gradient of thirty-five feet per mile, or, allowing for errors in the barometer, forty feet. Having attained this summit it strikes a tributary of the Jocko, and descending along that stream to the valley of the Flathead, the gradient being at forty feet, (assumed at fifty,) down the tributary of the Jocko, and down the main streams, as well as down the Flathead to its junction with the Bitter Root, twenty feet. By the barometer the average fall of Clark's Fork is about eleven feet per mile. The road is estimated to descend at a gradient of from fifteen to twenty feet per mile. After leaving the Jocko the road should follow the hills on the left side of the Flathead to a point seven miles above its junction with the Bitter Root; then crossing, it would follow the right bank of Clark's Fork as far as Big Rock; here it would cross, and, following down the left bank, would recross at the Cabinet. Then, tunnelling the Cabinet mountain three hundred yards, it would continue on the right of the river to Lake Pend d'Oreille, and on the northern side of that lake to its lower extremity. Both along Clark's Fork and the lake fifteen feet is about the difference of high and low water mark, and the road must therefore keep the sides of the hills, in some instances requiring high embankments. The tunnel at the Cabinet mountain would be through a formation of which fifty per cent. is rock, this being basaltic trap. The transit from Clark's Fork to the Spokane could be made with gradients of not more than twenty-five feet. It might be facilitated by making use of the valley of a small stream which empties into Clark's Fork, about twelve miles below the lake, and by a valley seen ten miles west of Clark's Fork, which appears to make into Cœur d'Aléne prairie. A bridge half a mile long would be required to cross Pack river. Excellent timber and good stone are found along the whole of this distance.

The crossing of the Spokane will not involve heavy work of bridging, excavation, or embankments; beyond, over the great plain of the Columbia, there are many practicable lines. But to resume.

HELL'S GATE CROSSING TO CROSSING OF BITTER ROOT, DISTANCE SIXTY-FIVE MILES.

Hell's Gate crossing is about three thousand three hundred and fifty-nine feet above the sea. The line, for ten miles and a half, crosses diagonally the Hell's Gate Ronde. There are several small streams and swales in this distance. Excavations and embankments moderate; grade 30.5 feet to the mile. Here a stream is crossed, and continuing down on the east side of the Bitter Root for sixteen miles, through, for nearly the entire distance, a wide, open valley, the Bitter Root is crossed. The line follows the west side of the Bitter Root over a broad and extensive prairie, partially wooded, when it recrosses the Bitter Root, and, continuing on its east side for thirty-one miles, crosses it for the third time just above the mouth of the St. Regis d'Borgia. In the above distance of sixteen miles, before making the first crossing of the Bitter Root, the work of excavation and embankment will be very light for about six miles, when a deep cut must be made through a ridge of rock. In three-quarters of a mile there is a deep re-entering of the river—a sort of delta formed by two streams, three-fourths of a mile apart. An embankment, forty feet high, and two bridges will be required to cross this place, and there will be curvature at both extremities of the embankment. Before reaching the crossing there will be a considerable rock excavation. The total descent in this distance is 1,465.3 feet, giving a grade of 22.5 feet to the mile.

To avoid excessive excavations and embankments, grades of forty feet should be adjusted to the ground, and considerable curvatures must be allowed.

The point of crossing the river is at a turn where a bridge, two hundred feet long, can be thrown nearly at right angles with the course of the stream without involving excessive curvature. The banks are only about fifteen feet high. Suitable building stone can be obtained in the immediate vicinity. After crossing, the line follows the next bank, over a low plateau under a side-hill, for about one mile and a quarter, when it comes round a point of rocks, involving a very heavy excavation, almost exclusively in rock, and there will be a very heavy excavation in rock for a mile and a half further; then a marsh has to be crossed, requiring an embankment of twenty feet. The remaining four and a half miles, before recrossing the river over the partially wooded plateau referred to, will also require, in places, large excavations and embankments. The plateau rises in terraces of from ten to twenty feet in height, and some curvature will be necessary, and an undulating grade, not, however, exceeding thirty feet to the mile.

The second crossing is of the same character as the first; about the same length of bridge and the same direction in reference to the course of the stream. The banks are forty feet high. The fall in this distance of seven and a half miles is 86.3 feet, and the average grade 17.5 feet. Continuing over on the east side of the Bitter Root the line follows, for eight miles, near to, or along the immediate banks of, the river, at from forty to eighty feet above the water level; or the same point could be reached by the line leaving the river in two and a half miles, and crossing in one mile a low point in a spur which runs in a northwest and southeast direction, involving a short tunnel, or deep cut, of about five hundred yards. The first mode is preferable. For five-eighths of a mile further the line will run along the water's edge, there being the whole distance a steep ridge of rocks, with broken stone at the base and partially up the slope. Trees are, however, growing out of the fissures of the rocks. Care must be taken to adjust curvature in this distance, and at two places the line must be built in the water. It will not interfere with the water way. For three and one-eight miles further the line follows the plateau, two streams in this distance requiring inconsiderable bridges. This plateau is thirty to seventy feet above the river. Then one-eight of a mile side-hill work; curvature fifteen hundred feet. Then comes a beautiful partially-wooded prairie for four and one-fourth miles. Excavations and embankments moderate. There will be half a mile of side-hill work during the next two miles. We then cross a fine mountain stream, and come to a plateau again, for three and three-fourth miles, with terraces, as described in the plateau on the west bank of the river, and situated in a large re-entering. For one-half mile some side cutting, when a stream is crossed; and continuing up a plateau about thirty feet above the water level of the river, for half a mile, we come to high, steep bluffs stretching along the river for three hundred and fifty yards. The banks for this distance are liable to slide, and it is the only point of the line, on this division, where slides are liable to occur, for the fixed regime of all the other banks and side-hills is shown by the forest growth on their sides. These bluffs can be passed by a bridge of a single arch, resting on abutments on the fixed river banks at the end of the bluffs, and running along the river side. If a slide occurs it will pass under the arch of the bridge. The next two miles is along a plateau ten to twenty feet above the water level, with but moderate excavations and embankments, when two spurs have to be passed, not involving heavy work, and requiring, to pass to the plateau beyond, some curvature and side cutting. Then for three and five-eighths miles the line, with but little curvature, can be easily located, when for one-eight of a mile side-hill work will be required, when we come to a prairie, which extends along the line for three-eighths of a mile, when a sharp point comes down that will require a deep cut, or a short tunnel. For three-eighths of a mile side cutting, and for one and a half mile a plateau eight to ten feet above the water level, when the river has to be crossed again. The whole fall from the second to the third crossing of the river is twenty feet. The line at the crossing of the Bitter Root, above the mouth of the St. Regis Borgia, is two thousand eight hundred and ninety-three and one-tenth feet above the sea.

The materials for construction down the Bitter Root are very abundant. There will be no practicable difficulty in procuring building stone. There are many navigable reaches of the river for boats and scows. Stone can easily be transported by the river to the point where it may be needed. Good building stone is to be found at many points on the river and in the adjacent country. The bridge could, if necessary, be built of the timber of the country.

The third crossing of the Bitter Root will be by a bridge one hundred and fifty yards long. Banks, gravel on both sides, ten to fifteen feet above the highest water. Greatest rise and fall of the river eleven feet.

CROSSING OF BITTER ROOT TO ENTRANCE TO TUNNEL THROUGH THE CŒUR D'ALÉNE MOUNTAINS—DISTANCE THIRTY-FIVE MILES.

In this distance the line rises one thousand and ninety-six and ninety-three hundredths feet, reaching an elevation of three thousand nine hundred and ninety and three hundredths feet above the sea, and giving an average gradient of thirty-one and four-tenths feet to the mile. The gradients in the immediate valley of the river are as follows on this distance: Twelve and one-fourth miles, thirteen and three-tenths feet to the mile; three and three-fourths miles, six and seven-tenths feet per mile; two and a half miles, forty-three and five-tenths feet to the mile; seven miles, thirty-three and six-tenths feet to the mile; two and a half miles, natural grade of the surface sixty-nine and six-tenths feet per mile, to which sixty feet grades can be adjusted two and three-fourths miles, twelve eight-tenths feet to the mile; one mile, seven and six-tenths feet; and three and one-fourth miles the natural surface is one hundred and eight feet to the mile. Sixty foot gradients can be adjusted on this distance by careful side-hill location, minimum curvatures, and heavy excavations and embankments; and this will be the character of the work for this grade for the last five miles of the St. Regis Borgia section before entering the tunnel, with this exception: there will not be excessive excavations and embankments on this section. To avoid excessive curvature, the points in turns of the river will have to be sternly dealt with. Nor will there be much rock cutting. There will, however, be a great amount of bridging—some considerable structures—as the river must be crossed obliquely. A single arch will always be sufficient. It will sometimes be necessary to resort to side walls. The trail crosses the river forty-four (44) times. The number of bridges will be much less; several tributary streams to be bridged; much culvert work; road bed to be well raised. The valley is not subject to overflow; the banks are four to eight feet above water level; several places covered with water at its highest stage. Greatest rise and fall near the mouth of the St. Regis Borgia about five and a half feet; sixteen miles higher up, four feet. There will be considerable wood to cut through and much gravelling. The wood will generally be a small growth in the river bottoms. The materials for construction will be literally inexhaustible. Good limestone was observed at several points, especially about midway of the section.

TUNNEL AT SOHON'S PASS OF THE CŒUR D'ALÉNE MOUNTAINS.

This tunnel will be one and three-fourth mile, in easily worked limestone and earth. It passes from the Cœur d'Aléne to the St. Regis Borgia in a south by east course, making nearly a right angle with the general course of the road.

The summit is at the eastern debouche, at an elevation of 3,990.03 feet above the sea. It descends to the west at a gradient of sixty feet to the mile, and its elevation on the western extremity is 3,877.7 feet above the sea. The summit level of the divide on the usually travelled trail is 5,089.7 feet.

ROAD TO CŒUR D'ALÉNE MISSION—DISTANCE FORTY-EIGHT AND A HALF MILES.

In this distance the line falls 1,586.9 feet to an elevation of 2,290.0 feet above the sea, and giving an average gradient of 32.74 feet to the mile. The grades along the immediate valley of the river are as follows:

¼ mile	94.8	feet to the mile.
1 mile	101.1	do.
½ mile	131.8	do.
½ mile	131.4	do.
¼ mile	4.3	do.
1 mile	79.2	do.
3½ miles	66.2	do.
3½ miles	56.1	do.
8 miles	28	do.
6 miles	60.6	do.
5 miles	38.34	do.
8 miles	1.17	do.
11 miles	3.6	do.
48½ miles, fall 1,586.9, grade	32.74	do.

For the first 10½ miles from the tunnel the road must be very carefully located along the side-hills north of the river to use sixty feet gradients. The side-hills run gently to the river. There is a narrow, open valley for two and a half miles to the point where the trail crosses the river to pass over the divide, and for four and a half miles further the route is through wood, sometimes of small growth. In this distance three streams are crossed. The next nine miles will require great care in location. The trail passes over low side-hills north of the river, and in some cases a mile from it; and these side-hills come well down to the river, in some cases with a steep slope. The excavations and embankments will be large, and in some instances sustaining walls will be required. Four streams, and several places where water runs in the spring, occur in this distance. Crossing then a low place for three-fourths of a mile there are two sloughs. The road passes through a very heavy growth of cedar, and in one-fourth of a mile reaches the point of junction with the trail over the mountain to the south of the Cœur d'Aléne river. Here a stream comes in from the south. In the next six miles the Cœur d'Aléne is crossed on the trail six times, but the road can be located without crossing the river more than half that number of times. Thus far, except in the low places and forest of cedar referred to, the river does not overflow its banks. The next thirteen miles the river is crossed sixteen times on the trail, nine of which are within the distance of two and a half miles, and in the remaining eleven miles it is crossed but twice. In these last two distances of twenty-four miles there are sections where the road will pass over wet and marshy places. There will be some, though not excessive, rock cutting. The whole section, from the tunnel to the mission, will have a large amount of bridge and culvert work. The bridges will not be difficult or costly structures, but frequently they must run quite obliquely to the course of the river to avoid short curvature. The bridges may be wooden structures. The mountain pine in the vicinity will furnish abundant material for this and all other purposes of construction. There is good building stone at several localities, limestone up the stream and slate lower down; gravel, sand, and clay occur at convenient points. The highest rise and fall of the river is four feet.

CŒUR D'ALÉNE MISSION TO CROSSING OF COLUMBIA—DISTANCE 181¾ MILES.

The line keeps north of the Cœur d'Aléne river and lake, and crossing the Spokane, or, more properly speaking, Cœur d'Aléne near the eastern edge of the Cœur d'Aléne prairie, passes in nearly a straight direction to the main Columbia, near but above the mouth of the Yakima. The line could keep still further down the Cœur d'Aléne and Spokane to a junction with the railroad line reported practicable as the results of the explorations of 1853–'54. The route described above is unquestionably practicable, the whole country having been under view; but great care will be required to locate a crossing of the river, and to gain the plateau beyond; for there are spurs running down from the south to the Cœur d'Aléne river and lake which have to be turned.

But between the river and Hangman's creek there is a divide which will have to be surmounted, and corresponding to the ridges found in other parts of the great plain.

The distance from the mission to the crossing of the Cœur d'Aléne is twenty-seven miles. There will be much heavy work on this distance, considerable curvature and some rock excavation. The route, after leaving the mission two miles, will pass through a rolling and wooded country interspersed with prairies for about eighty miles. The remaining distance to the Columbia is destitute of timber, a distance of about one hundred miles. Except for this portion, timber, wood, building stone, sand, clay, and gravel, abound for purposes of construction. For the portion destitute of timber the supply must come from the extremities.

The Upper Columbia will furnish an inexhaustible supply. There is no danger of a deficiency of water, as there are many streams and lakes along the route.

The fall from the Cœur d'Aléne mission to the crossing of the Spokane is about one hundred and ninety-eight feet in thirty miles, giving an aggregate grade of six and three-fifths feet to the mile; and from the crossing of the Spokane to the crossing of the Columbia, fifteen hundred and ninety-eight feet in one hundred and fifty-one and three quarters miles, or an aggregate gradient of ten and a half feet to the mile. But there will be several summits in this distance and a maximum summit of about two thousand six hundred feet above the sea. It is not probable that gradients exceeding forty to fifty feet to the mile will be required along this distance.

CROSSING OF THE COLUMBIA TO SEATTLE, ON PUGET SOUND—DISTANCE 220 MILES.

The Columbia river for fifteen miles above the mouth of the Yakima is four hundred yards wide, with sand and gravel banks thirty feet high. The railroad line passes up the valley of the main Yakima to the Snoqualmoo Pass, where there are two routes for travelling through the divide, one being by a route south, and the other by a route north of Lake Kitchelus. The first brings the line to the valley of the Nooknoo or Cedar creek, which can be followed down to its junction with the stream flowing from the Dwamish lake to the Dwamish river, near the outlet of the lake. The line then runs in nearly a straight course to Seattle; or following down the Nooknoo twenty-nine miles and a half, the line may take the summit and the northern slope of the low ridge separating Lake Mowee from the valley of the Snoqualmoo, and from that taking a spur running from the Nooknoo Falls to those of the Snoqualmoo, reach the latter falls at a distance of forty-five miles from the tunnel; thence the distance to Seattle is thirty miles, and the grades do not exceed twenty feet. The route north of Lake Ketchelus comes immediately upon the waters of Snoqualmoo;

and although no observations have been taken for altitude, intelligent gentlemen who have been over both routes state that it is lower and involves less tunnelling than the route south of Lake Ketchelus.

There are two modes of piercing the mountain south of Lake Kitchelus: First, by means of a tunnel four thousand yards in length from the level of Lake Willailootzas, two thousand nine hundred and ninety-three feet above Vancouver; second, by a tunnel eleven thousand eight hundred and forty yards long from the level of Lake Kitchelus, two thousand three hundred and eighty-eight feet above Vancouver. The average grade to the Snoqualmoo Falls, with the use of the long tunnel, will be forty-six and three-tenths feet per mile; and with the use of the short tunnel fifty-nine and eight-tenths feet per mile.

The ascent up the valley of the Yakima is as follows:

From the crossing of the Columbia to the commencement of the pine timber is a distance of ninety-six miles. The general character of the valley to this point is wide, open, and terraced; the ground of sand, gravel, or loose stones; but little clay or vegetable mould; curves easy; long stretches of straight road perfectly practicable. In this distance there are five points where the hills come close to the river, making, at most ten miles of side cutting necessary. This cutting is generally in earth, loose stones, or trap rock, easily broken into blocks. In addition to these five points, the last eight miles of the ninety-six will be principally side-cutting in earth, gravel and sand; the work light, and no very high slopes. In the first eighty miles from the Columbia the grade will be twelve and a half feet to the mile; in the last sixteen miles it will be 8½ feet to the mile. By keeping thus far the north bank of the Yakima, the only bridges of any consequence will be two, over streams each about seventy feet in width.

At some place in this vicinity it would be advisable to cross to the south bank of the Yakima, which is here about forty yards wide; good crossing easily found; plenty of timber on the spot; stone for masonry within twenty-five miles by water. The road now keeps to the valley twenty-one miles further on, four miles beyond Ksitkas, passing through open pine woods; soil light, sometimes gravelly; about two miles side-cutting; grade eight feet to the mile. If the short tunnel be used the road at this point must leave the valley, take a side location on the northern slope of the mountains bordering the valley on the south and ascend eight hundred and ninety-five feet in eighteen and a half miles, giving a gradient of forty-eight and four-tenths feet per mile, in fifty per cent. rock. The plateau of Willailootzas, one mile long, will be entered by a curve, with a radius of about two thousand feet, and the road pass along the north bank of the lake, with side locations in eighty per cent. trap rock, easily worked. This lake should be partially drained; its shores are steep and of broken stone.

There will be some little difficulty in preparing a proper depot for the workmen, tools, &c., at the entrance of the tunnel, or, if the long tunnel be used, then, commencing at the point eighteen and a half miles east of Willailootzas, there will be eighteen and a half miles with a gradient of fifteen and two-tenths feet per mile, and with but little side cutting, through a thickly timbered country as far as Kitchelus.

Both tunnels will pass through solid rock (silicious conglomerate) and there will be cutting through rock of similar character on the mountain spur bordering the valley of the Nooknoo. Yellow pine grows abundantly on the Yakima, ninety-six miles from its mouth, and can be rafted down at high water. Granite can be brought down from a point about one hundred and forty miles above the mouth of the Yakima, and good sandstone and limestone are to be found on Puget Sound.

Seattle is an admirable harbor for a great railroad depot, being land-locked, defensible, accessible, and commodious. The harbor at the entrance of the Snoqualmoo, or, as it is named in the lower part of its course, the Snohomish river, has mud flats, with a good harbor between the flats and Point Elliot to the south. The suggestion is, whether the line may not follow down the Snoqualmoo on its north bend, cross over to Whidby's island, and the depot be established on its western shore nearly opposite Point Townsend. This will require works of the largest and most expensive character, for an artificial harbor must be made by a breakwater midway between the island and the opposite shore. When it is recollected that with such a breakwater—for such a form and position can be given to it as that a heavy battery, with a keeper's tower, can be planted on it—the extensive waters of the sound can be defended by a single system of works at Port Townsend, the suggestion may not be altogether without significance. A small work would be, of course, required at Deception Passage.

BRANCH ROAD DOWN THE COLUMBIA TO VANCOUVER, AND EXTENSION VIA LINE OF COWLITZ RIVER TO PUGET SOUND.

This branch leaves the main trunk twenty miles before reaching the Columbia. There should, if practicable, be but one bridge crossing of the Columbia, for the two branches, supposing the branch down the Columbia should keep along its south bank, as minute surveys can determine the particular details. On the north side of the river the party of Mr. Tinkham, in 1853, with Stevens, found it necessary in only two instances to cross the rocky spurs which jut out from the river bluffs. The Columbia river pass is not only practicable, but is remarkably favorable. The only tunnel required will be to effect the passage around Cape Horn mountain. This will not exceed seven hundred feet in length, and a close examination may prove even this unnecessary. There need be no gradient to exceed ten feet per mile, but considerable side-cuttings in the rock will be necessary.

The high floods to which the river is subject are the most serious obstacles to obtaining the advantages of cheap construction offered by its valley. To avoid these it will be necessary to run the road at some distance above the water; but as much of the slope consists in debris, workable with the shovel, embankments will be easily made, and when constructed will be of the most durable kind. At eastern prices this work might be done at fifty cents per cubic yard.

The tunnel through Cape Horn mountain would cost, at eastern prices, say sixty-five dollars per lineal foot—a high estimate, considering the character of the road. The easy access to this part of the route will make it cheaper of construction than parts of the same character further in the interior.

The bluffs along the Columbia cease near Cape Horn, and passing through a level bottom land, partly wooded, as far as the Cowlitz, it turns northward from the Columbia, and follows the wide Cowlitz valley, with an easy ascent, to the prairies occupying about half of the country on the line from thence to Puget Sound. Along the eastern shore of Puget Sound, from Steilacoom to Seattle, it passes through dense forests for most of the way, and crosses several large streams, which will probably make a terminus higher up the sound desirable for a route approaching by way of the Columbia. Good building stone, excellent timber, and abundant water, is found on this part of the route, while fine gravel, constituting the soil through most of the way, offers a superior material for the road-bed. If we pursue the Hell's Gate route, *via* Mullan's Pass, a railroad line can be laid across the Rocky Mountains with only a mile tunnel through the divide, which is but one and a half measured mile from base to base, and that no excessive gradients will be required on the eastern approach. The descent down the valley of the Little Blackfoot and Hell's Gate is exceedingly favorable. Thus a line can be laid down from the Mississippi to Olympia, on Puget Sound, with but short and few tunnels, but which will be two hundred and seventy-six miles longer than the route by Cadotte's, the Cœur d'Alêne and Snoqualmoo

Passes to Seattle. We cross the Rocky Mountains by the Northern Little Blackfoot or Mullan's Pass, then follow down the Little Blackfoot and Hell's Gate valleys, cross over the Jocko divide to Hell's Gate, follow down Clark's Fork to below the Pend d'Oreille lake, cross over to the Spokane, and, finally, after passing over the great plains of the Columbia, follow down the Columbia valley to near the mouth of the Cowlitz and reach the sound by the easy and practicable line of the Cowlitz and intermediate country.

By this route the distance to Olympia from St. Paul will be two thousand and forty miles, against one thousand seven hundred and sixty-four miles, the distance to Seattle by the route of the tunnels.

The distance to Seattle by the *no* tunnel route will be 2,092 miles. By the tunnel route the elevation above the sea is as follows:

BRECKINRIDGE TO SEATTLE.

No. of miles at an elevation above 0 and less than 1,000 feet,	130 miles.
No. of miles at an elevation above 1,000 and less than 2,000 feet,	433 miles.
No. of miles at an elevation above 2,000 and less than 3,000 feet,	733 miles.
No. of miles at an elevation above 3,000 and less than 4,000 feet,	180 miles.
No. of miles at an elevation above 4,000 and less than 5,000 feet,	62 miles.
No. of miles at an elevation above 5,000 and above.............	6 miles.

Summit level, 6.046.

Tunnel, at an elevation of 5,161.52.

On the route from Breckinridge to Vancouver the distance and elevations are as follows:

Below 1,000 feet below the sea..............................	243 miles.
Between 1,000 and 2,000 feet below the sea....................	391 miles.
Between 2,000 and 3,000 feet below the sea....................	648 miles.
Between 3,000 and 4,000 feet below the sea....................	178 miles.
Between 4,000 and 5,000 feet above the sea....................	61 miles.
5,000 feet or more above the sea..............................	6 miles.

The sum of ascents and descents from Breckinridge to Seattle is 21,787 feet, and to Vancouver 17,587. Equated distances from Breckinridge to Seattle, *via* Cadotte's Pass, 1,957.14; equated distances from Breckinridge to Vancouver, *via* Codotte's Pass, 1,859.69.

Before giving the estimate, I will state that there are many advantages in bringing the line to the Missouri rather than taking it from Milk river and crossing the Marias and Téton high up towards the mountains. The cost is diminished thereby; the road is brought at once directly to the head of navigation of the Missouri; it dispenses with the necessity and expense of a spur road; it renders unnecessary the reservoir for water at Grizzly Bear lake; there will be the most ample supply of water along the line of the route about to be estimated upon; Box Elder, Sun river, Elk Fork, the Dearborn, the several tributaries of the Dearborn, and the creeks flowing westward from the divides of Cadotte and Lewis and Clark will, as well as the Missouri, furnish an inexhaustible supply of the purest water; it will bring the whole of this portion of the route into the close vicinity of a well-wooded region; it will effect a great saving in transportation; it will be near water-power; it will hasten by six months the completion of this portion of the road; the old location, from Sun river to the Dearborn will involve exceedingly heavy excavations and embankments.

ESTIMATE OF COST.

The estimate of cost of road is not given for the distance east from Breckinridge, on the western boundary of Minnesota, to which point the Minnesota and Pacific Railroad Company have located a road under the recent grants of Congress. Their route crosses the Mississippi near the Falls of St. Anthony, does not deflect more than 27 miles at any point from an air-line, and saves 20 miles in distance over the surveyed routes. Moreover, with means at hand it can be built for less than the estimate of $25,000 per mile, viz: for about $21,000 or $22,000 per mile.

One estimate is given of the cost of the road from Breckinridge to Seattle and Vancouver, both by Cadotte's and Lewis and Clark's Passes—first, by passing the plateau generally, and second, by the Missouri Great Falls and Sun river, as explained in this paper.

Estimate of cost of road from Breckinridge to Seattle, via Fort Union, Fort Benton, Cadotte's Pass, Cœur d'Aléne mission, north of the Cœur d'Aléne lake, and the Snoqualmoo Pass, using the long tunnel. Entire distance, 1,544.51 miles.

	Miles.	Cost per mile.	Total cost.
Breckinridge to crossing of Milk river	712	$40,000	$28,480,000
Crossing of Milk river to point of departure from Box Elder creek	30	40,000	1,200,000
Thence to Fort Benton	51.5	80,000	4,120,000
Fort Benton to entrance to tunnel	102.2	70,000	7,154,000
Short tunnel, 2,640 feet, at $120 per foot	....	....	316,800
Tunnel, 22,123 feet, at $130 per foot	4.19	....	2,875,990
Thence to crossing of Hell's Gate	91.86	60,000	5,511,600
Thence to crossing of Bitter Root	65	50,000	3,250,000
Thence to entrance into tunnel	35	60,000	2,100,000
Tunnel, 1.6 mile, at $130 per foot	1.6	....	1,098,240
West end of tunnel to Cœur d'Aléne mission	48.5	60,000	2,910,000
Thence to point beyond crossing of Spokane	70.5	60,000	4,230,000
Thence to fork of line to Vancouver	91.25	45,000	4,106,250
Thence to crossing of Columbia	20.00	45,000	900,000
Thence to entrance to long tunnel	138.25	50,000	6,912,500
Long tunnel, 11,840 yards, or 6¾ miles, about $140 per foot, or $420 per yard.	6.75	....	5,000,000
Thence to Seattle	75.00	60,000	4,500,000
Total length in miles	1,543.60	....	84,665,380
Steamers on the Missouri and Columbia			1,500,000
Reservoirs, aqueducts, &c			2,000,000
Depots and permanent fixtures			1,750,000
Engineering and contingencies			5,000,000
Total			94,915,380
The cost of the short tunnel will be, 4,000 yards, or 2.247 miles, at $3 90 per yard		$1,560,000	
Add 4½ miles of road and difficult work, at $100,000 per mile		450,000	
		2,010,000	
Total cost of short tunnel			2,990,000
Total cost			91,925,380

Estimate of cost of road from Breckinridge to Vancouver, via Fort Union, Fort Benton, Cadotte's Pass, Cœur d'Aléne mission, north of the Cœur d'Aléne lake and the Dalles. Entire distance, 1,526.60 miles.

	Miles.	Cost per mile.	Total cost.
From Breckinridge to fork of line to Vancouver	1,303.60	$51,682	$67,352,880
Thence to crossing of Columbia	20.00	45,000	900,000
Thence to Dalles	113	60,000	6,780,000
Thence to Vancouver	90	100,000	9,000,000
	1,526 60	....	84,032,880
Steamers on the Missouri and Columbia			1,500,000
Reservoirs, aqueducts, &c			2,000,000
Depots and permanent fixtures			1,750,000
Engineering and contingencies			5,000,000
Total cost			94,282,880

Estimate of cost of branch road from Vancouver to Seattle.

	Miles.	Cost per mile.	Total cost.
From Vancouver to Seattle	172	$50,000	$8,600,000
Depots	....	....	150,000
Total cost of road	....	....	8,750,000

Recapitulation of cost of road from Breckinridge to Seattle, with a branch road to Vancouver, and a branch road from Vancouver to Seattle.

	Miles.	Total cost.
From Breckinridge to Seattle	1,543.60	$94,915,390
Branch to Vancouver	223.00	16,930,000
Branch from Vancouver to Seattle	172.00	8,750,000
	....	120,595,390

The following is an estimate of the cost of road, leaving the route on Sun river, passing up that river to Elk fork; thence, along that fork, to Lewis and Clark's Pass, and thence to its junction with the Big Blackfoot. The cost from Fort Benton to Hell's Gate, as per preceding estimate, is $15,858,390. Distance, 198.25 miles.

The cost of this portion of the route, by Lewis and Clark's Pass, will be as follows:

	Miles.	Cost per mile.	Total cost.
Fort Benton to Sun river	55.5	$55,000	$3,052,500
Thence to ten miles above forks	48	45,000	2,160,000
Thence to entrance to tunnel	19.121	100,000	1,912,100
Tunnel, at $120 per foot	2.129	....	1,348,934
Thence to entrance into Big Blackfoot	11.875	55,000	653,125
Thence to Hell's Gate	86.5	60,000	5,190,000
	223.125	....	14,316,659

By taking Lewis and Clark's Pass, as above, the distance is increased 24.875, and the cost increased $1,541,731. The route by the Missouri to the mouth of Sun river will increase the cost over the route by the plateau from Fort Benton to Sun river as follows:

	Miles.	Cost per mile.	Total cost.
Fort Benton, *via* Missouri, to Sun river	52.5	$80,000	$4,200,000
Thence up the river to where route over plateau strikes it	10.5	45,000	472,500
	63	....	4,672,500
Over plateau from Fort Benton to Sun river	55.5	55,000	3,052,500
Increase of distance and cost	7.5	....	1,620,000

GENERAL RECAPITULATION.

Breckinridge to Seattle.

	Distance.	Cost, long tunnel and cascades.	Cost, short tunnel and cascades.
Platte route, *via* Cadotte's Pass	1,543.6	$94,915,380	$91,925,380
Platte route, *via* Lewis and Clark's Pass	1,568.475	93,328,649	90,338,649
Missouri and mouth of Sun river route, *via* Cadotte's Pass	1,551.1	96,560,380	93,570,380
Missouri and mouth of Sun river route, *via* Lewis and Clark's Pass	1,575.975	94,973,649	91,983,649

Breckinridge to Vancouver.

	Distance.	Total cost.
Platte route, *via* Cadotte's Pass	1,526.6	$94,292,880
Platte route, *via* Lewis and Clark's Pass	1,551.475	92,696,149
Missouri and mouth of Sun river, *via* Cadotte's Pass	1,534.1	95,927,880
Missouri and mouth of Sun river, *via* Lewis and Clark's Pass	1,558.975	94,341,149

ASTRONOMICAL DATA.

In submitting the subjoined astronomical report, which has cost us much labor both in the field and office, I take much pride in stating that it comprises the first series of longitude observations ever made across the continent north of the 42° of longitude. This section of our domain has never been the field where extended detailed surveys have been conducted. The first party, under Lewis and Clark, sent out by the government to map this region, failed to report any longitude observations, as is fully set forth in an extract from a letter of President Jefferson on the subject, which may be found in the seventh volume of his published works, page 224, and which is as follows:

"I had long deemed it incumbent on the authorities of our country to have the great western wilderness beyond the Mississippi explored, to make known its geography, its natural productions, its general character, and inhabitants. Two attempts, which I had myself made formerly, before the country was ours, the one from west to east, the other from east to west, had both proved abortive. When called to the administration of the general government I made this an object of early attention, and proposed it to Congress. They voted the sum of five thousand dollars for its execution, and I placed Captain Lewis at the head of the enterprise. No man within the range of my acquaintance united so many qualifications necessary for its successful direction; but he had not received such an astronomical education as might enable him to give us the geography of the country with the precision desired. The Missouri and Columbia, which were to constitute the tract of his journey, were rivers which varied little in their progressive latitudes, but changed their longitudes rapidly at every step. To qualify him for making these observations, so important to the value of the enterprise, I encouraged him to apply himself to this particular object, and gave him letters to Dr. Patterson and Mr. Ellicott, requesting them to instruct him in the necessary process. Those for the longitude would, of course, be founded on the lunar distances. But, as these require essentially the aid of a timekeeper, it occurred to me that, during a journey of two, three, or four years, exposed to so many accidents as himself and the instrument would be, we might expect with certainty that it would become deranged, and in a desert country where it could not be repaired. I thought it then highly important that some means of observation should be furnished him, if any could be, which should be practicable and competent to ascertain his longitude in that event. The equatorial occurred to me as the most promising substitute. I observed only that Ramsden, in his explanation of its uses, and particularly that of finding the longitude at land, still required his observer to have the aid of a timekeeper. But this cannot be necessary, for the margin of the equatorial circle of this instrument being divided into time by hours, minutes, and seconds, supplies the main functions of the timekeeper, and, for measuring merely the interval of the observations, is such as not to be neglected. A portable pendulum, for counting, by an assistant, would fully answer that purpose. I suggested my fears to several of our best astronomical friends, and my wishes that other processes should be furnished him, if any could be, which might guard us ultimately from disappointment. Several other methods were proposed, but all requiring the use of a timekeeper. That of the equatorial being recommended by none, and other duties refusing me time for protracted consultations, I relinquished the idea for that occasion. But, if a sound one, it should not be abandoned. Those deserts are yet to be explored, and their geography given to the world and ourselves with a correctness worthy of the science of the age. The acquisition of the country before Captain Lewis's departure facilitated our enterprise, but his timekeeper failed early in his journey. His dependence then was on the compass and log line, with the correction of latitudes only; and the true longitudes of the different points of the Missouri, of the Stony Mountains, the Columbia, and Pacific, at its mouth, remain yet to be obtained by future enterprise."

No other party occupied this field till 1853, when Governor Stevens contemplated supplying this want so long felt for the correct geography of the country. Having been a member of his expedition, and familiar with the special difficulties under which this branch of his duties labored, I deem it germain to this portion of my report to here relate them: In the organization of his expedition, Captain Joseph Roberts, then of the 4th artillery, was detailed to accompany him across the country as chief astronomer; but within a few days of starting from St. Paul's Captain Roberts was relieved, when the duties devolved upon G. W. Stevens, (nephew to the governor,) James Doty, and two Hungarians. When one hundred and fifty miles west of St. Paul's these two Hungarians, for reasons satisfactory to the governor, were discharged, and young Stevens left almost alone, for Mr. Doty made no profession to astronomical ability. Young Stevens himself was not a practical astronomer, and the transit was not set up before reaching the mouth of the Yellowstone. At this point the observations were placed under the charge of Lieutenant A. J. Donaldson, late of the United States engineers, who, already occupied with labors that monopolized his time, gave only a general supervision to the subject. The consequence was that Stevens reached the Pacific coast without having collected any observation for a single longitude. In making his report to Congress the statement was made "that the astronomical observations being placed in charge of Lieutenant Donaldson, the latter failed to report any except for latitude." The sensative nature of Donaldson construing this to be a thrust at his ability to observe for longitude, protested, in an official letter to the Secretary of War, and which was published with Stevens's volume Pacific Railroad Reports.

Stevens regretted this loss very much, and tried to meet it by getting an especial appropriation to send his nephew over the line a second time; but in this he failed to get the necessary legislation.

Thus was this second opportunity allowed to pass without any fixed position on so long an east and west line being determined. Therefore, in taking the field, in 1858, the department authorized me to supply this information, which has been done, and the following tables will be found to be replete in all the material for these determinations.

The data have been collected with commendable zeal by Messrs. Weisner, Kolecki, and Culligan, and we had the good fortune of bringing back to Washington our transits without any accident, and our five chronometers without one being allowed to run down. To those specially interested in this branch of science, the tabulated series will be of great value; and to those who would wish to review the originals, I would refer to the many field-books now deposited with the Topographical bureau, where all our original maps, tracing sketches, and field-books are deposited. One of the results of our labors show that both Fort Walla-Walla and Fort Benton have been thrown too far to the east—the former by 15′ and the latter by 4′ in arc.

WASHINGTON, *D. C., February* 1, 1863.

DEAR SIR: I have the honor now to submit to you the records of the astronomical and meteorological observations made in connexion with the expedition to explore and open a military road from Fort Walla-Walla to Fort Benton in the year 1859 to 1860. Volume A gives the comparisons of the chronometers and their relative rates for every day, assuming the rate of the sidereal to be zero. The results of the errors for every day, whenever moon culminations had been observed, are given in a table of the appendix. Volume B contains a pretty numerous series of sextant observations for time and latitude, generally on the sun's lower limb, some on Polaris and other stars, at twenty-eight stations, made by Mr. Theodore Kolecki, with three sextants, the time being recorded by myself, using generally sol. chron. No. 7961 for observations on the sun, or sid. chron. No. 525 for observations on stars, if not otherwise stated. The record for time observations is separated from that of the latitude observations at the beginning, but further on both are brought into one and the same convenient shape. The column headed "time at culm., and 2 meridian altitudes," or, shorter, "meridian, 2 alt.," shows sufficiently what can be reached through practice by a steady observer. The probable error of a result of a set of seven equal altitudes on the sun is in many cases smaller than ± 0*s*.2. The double altitudes, reduced to the meridian, give a probable error of ± *5*″, and even less, for a single observation. The index error has been observed frequently. The error of eccentricity, &c., of the sextant, has been determined from observations on objects north and south of the zenith, and checked by comparing the measured with the computed distant of α Virginis to α Scorpii, at Fort Walla-Walla, June 20. In the reduction of the time observations Captain Lee's tables have been used for the computation of the equation of equal altitudes, and the correction for the equation of time was taken from the American ephemeris. In the reduction of the latitude observations the following corrections are used:

1st. Correction for reduction to meridian, correcting first the meridian distance in time for rate of chronometer, going with the corrected argument in Captain Lee's tables, and using the factor sec. a cos. l cos. δ.

2d. Correction for change in declination of the observed object, when the sun was observed.

3d. Correction for vernier of sextant No. 1, for 57 div. on the limb = 59 on the vernier.

From these corrected double meridian altitudes the mean has been used, and its probable error determined. To this mean added the mean index error, and the error for eccentricity, &c., of the sextant; further the sum halved, and from that the refraction, corrected for barometer and temperature, subtracted, gives the true meridian altitude of the observed object. To this the semi-diameter and the parallax in altitude added, when the sun's lower limb was observed, gives the true altitude of the object's centre at the earth's centre; and adding the declination of the object with the opposite sign, gives the true altitude of the equator at the place of observation, or, by adding the north polar distance of the object with the opposite sign—when the object is north of the zenith—the latitude of the place of observation. In that manner the latitudes of nineteen stations are computed, and the results incorporated in the table of geographical positions. Also some equal azimuth observations have been recorded with the original record of the sextant observations, but, as the sun stood too high, are, in consequence, of little value for the determination of the magnetic variation. However, the results for this element are given in the above table, as obtained from direct bearings of the compass to natural and artificial marks of the northern and southern horizon, the astronomical azimuth of these marks being well determined by the observations contained in volume C, the book of transits. About 4,000 transits, over the mean wire of the nine which were generally observed, are recorded.

1. *Equatorial intervals.*—The intervals of the wires to the mean wire for more than 100 objects have been frequently determined and compared. Combining the same interval from the same star from a large number of observations into one mean, and bringing the results of a large number of stars with the factor cos δ together into one mean, the following result for equatorial interval was obtained for lamp west and upper culmination:

1.	2.	3.	4.	5.	6.	7.	8.	9.	
s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
+ 92.96	+ 69 86	+ 47.10	+ 23.33	— 0 20	— 23.45	— 46.59	— 69.90	— 93.19	± 0 035.

2. *Collimation.*—Polaris, λ Ursæ Minoris, and other circumpolar stars, have been frequently observed with lamp west and east on some or all of the wires. The observations gave an average result that all upper transits taken with lamp west are to be corrected by $-5s.50 \sec \delta$. At Walla-Walla the collimation was only determined at the beginning and the end in that way, the transit-stand being too high, and being afraid of disturbing the instrument; but the collimation for the intermediate observations could be very well determined from the observations themselves, as stars for that purpose were observed.

3. *Inclination.*—The level was frequently read with care, giving sufficient time to rest. Also stars observed in general for its direct determination to avoid the inequality of the pivots. Observations on zenith and circumpolar stars were made for the value of one division of the level scale, with the result: 1 division $= 1''.00$, and correction for inclination $= 0s.017\ b.\ \sec.\ \delta.\cos.\ z$, where $b = [w - e \times] + [w \times - e]$ or four times the inclination of the axis expressed in divisions of the level scale; b is tabulated in the record under the column "level." The mean is recorded when observations were made before, during, and after the transit of the object. For some objects the transits and level are given separately, to check the above results.

4. *Deviation.*—No opportunity was omitted to observe close together high and low stars for the determination of the azimuth. Also, some natural and artificial marks of the northern and southern horizon have been made use of to obtain the change in azimuth during the time of observation, by measuring it with the micrometer and the movable wire, the value of one division of the micrometer being determined to be $= 0s.04605. \pm 0s.00005$.

The correction for deviation $= a \sec.\ \delta \sin.\ z$, a being the deviation, or its change, just as needed.

In reducing the transits, a more expansive table than given by Captain Lee for the three transit factors, $\sec \delta$ $\sec \delta \cos z$ $\sec \delta \sin z$ has been used.

The observations recorded in volume four contain the following:

1. *Observations for time,* to determine the error of the chronometers and their absolute rate.

2. *Moon culminations and moon culminating stars.*—Great pains have been taken to get as many observations as could be got with the least handling or disturbance of the instrument for almost an hour before and after each transit of the moon's I or II limb. Observations for instrumental errors were made generally before and after that. In reducing these observations to obtain the absolute

longitude of the places of observations, the American ephemeris, Bessel's formula for interpolation, corresponding observations from Greenwich, Washington, Harvard College, and Cincinnati, have been made use of; further, Lieutenant J. M. Schofield's table of corrections to the AR. of the moon's I or II limb, and to the moon culminating stars of the American ephemeris, improved the results considerably. The final result of the longitude of each station is given in the table of geographical position.

3. *Observations on the sun and solar spots.*—The latter were first recognized at the Cœur d'Alêne mission by James Culligan, my assistant. I took the pleasure to chase one for about a week with the formula $\triangle$ AR. $= a + b$ sin. $(\beta + \gamma t)$. Where $\triangle$ AR. the difference in R. A. between limb and spot given by observation from day to day, γ the daily angular motion of the spot in its parallel at the sun. I computed for $\gamma = 12^\circ, 13^\circ, 14^\circ$, the remaining constants a, b, β, and also the remaining errors of the observations. Representing in a diagram the sum of these errors as ordinates for the abcissa γ, it indicated a minimum sum of errors for $\gamma = 13^\circ.15$. Adopting this as the true γ, and the earth at rest made the sun revolve within 27.4 days, and correcting this result for the earth's motion, 25.3 days was obtained for the time of rotation of the sun.

4. *Planets.*—All the planets, except the asteroids, have been observed. This speaks for the excellent quality of the telescope made by Throughton & Simms, as well as for the beautiful, clear blue sky over the Rocky Mountains. Even the asteroids would have been hunted up if the American ephemeris of 1859 and 1860 would have given the elements for finding them. None of them were discovered anew, neither the planet between Mercury and the sun.

5. *Satellites.*—The four of Jupiter have been observed frequently, and also one of Saturn; but no occultation could be observed without bringing the instrument out of its position.

6. *Occultations of stars* with the moon had not been observed, for the same reason. Saturn and Venus came very near the moon, the first at Walla-Walla, the second at Hell Gate, and would have been observed. At Hell Gate, April 24, Venus was visible to the naked eye all day, even at noon.

7. *Eclipses.*—Two of them were observed. One of the moon, at the Bitter Root, February 6, 1860, and one of the sun, on board the steamer Key West, passing Fort Lookout, on the Missouri, on July 18. By the last eclipse a great error was committed by myself. I was ordered by you, at Fort Benton, to go back to the divide of the Rocky Mountains, but before I went, got discharged by an order of the Secretary of War, Mr. Floyd. I followed the demon, when speaking to me, "follow the law of gravity." I went down the river, not knowing that gravity lifts the spirits upwards, as every child knows that reads the Bible. But you have forgiven me, as I was misled by—

8. *The comet*, first seen by J. Culligan with the naked eye, near the northwestern horizon, at Fort Benton, June 21, 9.50 p. m. As this stranger could not be observed in the meridian, the instrument was moved in azimuth, and transits taken in the direction north-northwest to south-southeast. Only a few observations were obtained. The light of the comet became very faint, in consequence of the twilight and moonlight, and disappeared in the aurora borealis, on July 30.

9. *Prime verticals, or observations with the transit.*—The telescope here is moved in a plane nearly vertical, through east and west. These observations are very well adapted for the determination of the latitude of a place, as nothing but a chronometer and a vertical plane through east and west are required. The equatorial intervals of the wires in the transit being known, further the collimation of the mean wire ascertained from transit observations, the reduction of the prime vertical observations from one side wire to the transit over the line of collimation was performed by the following formula:

For lamp $\left\{\begin{matrix}\text{south}\\ \text{north}\end{matrix}\right\}$, star $\left\{\begin{matrix}\text{east}\\ \text{west}\end{matrix}\right\}$, reduction $= F : \sqrt{M \pm 7.5\, F \text{ arc } 1''}$

For lamp $\left\{\begin{matrix}\text{south}\\ \text{north}\end{matrix}\right\}$, star $\left\{\begin{matrix}\text{west}\\ \text{east}\end{matrix}\right\}$, reduction = the same as above, read wires reverse with opposite sign.

F being the equatorial interval in second of time, — *5s.50* the mean collimation $M = \sin(L+D) \sin(L-D.)$

L being the latitude of the place of observation, and D the declination of the observed object.

A table has been constructed for lamp south, and another for lamp north, which gives at once for the argument log. M the reduction of one side wire to the transit over the line of collimation for each of the nine wires.

To reduce them further to latitude, the hour angle *p*, and the declination of the observed object was looked for in the American ephemeris, and then the latitude of the place of observation obtained by the formulæ: log. tang. L = log. tang. D — log. cos. *p*, supposing the instrument free of errors. The indications of the level have been simply converted into arc by the value of 1 div = 1.″00 and added.

For corrections to the assumed chronometer error and rate, the mean collimation and deviation have been determined from the observations themselves, by the use of differential coefficients to these small unknown quantities. The equations, which the observations furnish in great abundance, solved by the method of least squares, or some approximation to it, and then, with them, the above results for latitude corrected.

An investigation on the weight of the single results has been made and found to be directly proportional to $\sin^2 D$, and inversely proportional to $1+\sin^2 p$. Accordingly the following weights to the results of the principal stars of the Bitter Root latitude.

Star.	Capella.	α Cygni.	Vega.	ι Aurigæ.	β Tauri.	Arcturus.	Regulus.
Declination.	45° 51′	44° 47′	38° 39′	32° 57′	28° 29′	19° 54′	12° [illegible]
Hour angle..........	18 05	23 44	42 27	53 18	59 59	70 28	78 [illegible]
Weight.	10	10	8	6	5	2	1

METEOROLOGICAL DATA.

Vol. D. *Meteorological observations.*—These were made with Green's cistern barometer, No. 1273, aneroid No. 18314, dry and wet bulb, black and naked bulb, maximum, and a number of small pocket thermometers.

1. The barometric observations were made in order to use them for the determination of the absolute height of the principal stations. The accuracy of the resulting heights depends more on the season and the duration of the series than on a great number of observations made during a short time. I computed the probable error from a series of daily observations, three in nnmber, during 29 years, made by Professor A. Caswell, at Providence, Rhode Island, to be, respectively

	For—												
	The year.	September.	August.	June.	May.	December.	March.	April.	November.	July.	October.	January.	February.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Prob. error............	±32	±38	±40	±45	±48	±[illegible]	±52	±55	±56	±57	±57	±69	±67

Accordingly, a series of seven September months would have the same weight as a series of five years observations when worked with the mean without regard to weights. Further, the series at the Bitter Root during November, December, January, February and March, has the weight 14, and that at the Cœur d'Aléne mission during the short time of August and half of September the weight 10, taking the weight corresponding to the probable error of 100 feet as unit.

The results of the absolute heights become considerably improved by correcting the mean barometric pressure of the air for its periodic and non-periodic variations as collected by the Smithsonian Institution in A. Guyot's meteorological and physical tables.

2. The observations with the aneroid were made for the determination of the differences of heights between the intermediate points and the principal stations. Another Green's cistern barometer, No. 1275, was left at Walla-Walla in care of Thomas A. McParlin, assistant surgeon United States army, to make corresponding observations for this purpose. A series of daily observations, three in number, during one year, has been thankfully received.

As the distance from Walla-Walla increased, barometer 1273 was left stationary during the time the aneroid was travelling on foot or on horseback. In that way a profile was obtained of the road from Cœur d'Aléne mission to the Bitter Root, and checked by actual levelling by Mr. W. W. Johnson. The differences gave a probable error of five feet to points determined by the aneroid, the determination by actual levelling being correct.

The results of the heights of the principal stations, and of some intermediate points, are annexed to the table of geographical positions.

3. The observations for temperature contain:

a, the temperature of the mercury in the barometer in the column headed "attached."

b, the temperature of the air in the shade in the column headed "det," or "dry."

c, the dry and wet bulb observations for the hygrometric condition of the air.

d, black and naked bulb observations for the relative heating power of the sun.

e, the temperature observations of the soil at the surface, and of the air half an inch, one foot, and four feet above the ground, exposed to the action of the sun, for the interesting study of the radiant heat from the surface of the earth.

f, the temperatures of the water in rivers and creeks for the determination of their exceedingly simple laws, as herewith almost the hour of the day and the distance between two points could be determined. A single observation of the temperature of the water in a spring at any time gives the yearly mean temperature of the air in shade generally just as accurate as a series of observations made direct in the air during a number of years. No spring has been passed, therefore, without taking a drink and a temperature. The number of springs increased towards the foot of the mountains, and are found at all heights, even at 6,000 feet above the level of the sea.

The mean temperature of the air in the shade between the Cascades and the Rocky Mountains, for the 47th parallel, reduced by the Smithsonian coefficient of 300 feet for 1°, increase in temperature in going down to the level of the sea, may be set at 55° F.; that is, 2° more than at Washington, D. C., latitude 39°.

By comparing the observations for temperatures of the same time at stations of different heights, the above coefficient was found to be the same for night observations, but, for the day, 200 feet would come nearer the truth. By ascending 4,000 feet above the Cœur d'Aléne mission, during moonlight on the night of September 10 to 11, the temperature of the air stood actually over 10° higher than in the valley for this special case.

4. *The amount of rain and snow that actually fell.*—The yearly amount of rain within the above geographical limits may be set down at 20 inches of water, or to one-half that falls in the District of Columbia upon the same area, or to 50 per cent. more than falls upon the most fertile portions of Germany.

In winter it is snowing frequently by quarter inches as a whole day's labor, to be destroyed the following day by a warm sun. If any snow should remain, the temperature of the air near zero, or even sometimes 40° below zero, the freezing point of mercury, the result of an excessive clear and calm night will freeze the snow to an ice crust for the deer to walk on without snow-shoes, and, on the morrow, to enjoy the bright sun with a temperature of 70° and more.

The line of eternal snow must be over 8,000 feet above the level of the sea, as the yearly mean temperature of the air in shade can be expected only at heights 7,200 feet above the ocean. The following table will represent the depth of snow in inches lying on the ground on the bank of the Bitter Root during the winter of 1859 and 1860, at different dates:

	Depth.		Depth.
At November 5	0.0	At January 10	14.0
November 10	3.5	January 14	10.0
November 20	0.5	January 29	7.0
December 4	18.0	February 16	6.0
December 21	7.0	March 21	0.0
December 29	6.0		

Towards Sohon's Pass the maximum depth of snow increased in two ratios: For the distance of each mile from the Bitter Root towards the divide, ½ an inch; and, for each 100 feet above, 1¾ inch has to be added.

Along the valley of the Bitter Root the maximum depth of snow is almost independent of the distance, and the coefficient for height considerably smaller. Within heavy timber, the ground and snow remains unfrozen; the snow may accumulate at high points to the depth of 7 feet, even 10 feet. But, by avoiding the heavy timber, the snow will offer no great obstruction to travel with horses or locomotives from the Missouri to the Columbia.

5. *The observations with the water-gauge*, besides the average breadth, depth, fall, and velocity of the water in rivers and creeks, form important hydrographic informations for agriculture, navigation, and industrial purposes.

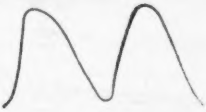
6. *Wind and clouds.*—The force of the wind is reduced considerably by the broken surface of the ground on the western side of the Rocky Mountains. Therefore, calms are frequent, and camp life very pleasant, especially in the woods, even during the winter. The excessive cold of a few hours is checked by an overclouded sky of long duration, and the excessive heat, during the days of summer, by a gentle, cool, and healthy mountain breeze. At Walla-Walla a temperature of 108° in the shade has the same effect on a healthy body with wet skin as a temperature of 90° at Washington. The direction of the wind is very variable. The smoke of the camp fires is moving around the horizon within a few minutes direct and reverse to Dove's law; the direct motion, following the sun, being the preponderate, especially for the upper wind. That, during the day, the warm air moves up and the cool air down has been observed frequently at Walla-Walla. Apparently, by a calm air, a cylinder of dust about

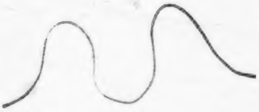
200 feet in height was formed by these two currents of the air, and lasted a few seconds. But generally the heated air of the valley climbs up the sides of the mountains, heating their slopes additionally, *less* during the day, *more* during the night, and is ascending at the top still further on to fill the places of the cool air that falls down in the morning perpendicularly into the valley. Therefore, during the night and morning, the mountains are surrounded by heated air, and the cool air fills the valleys and covers the plains in order to become heated the following day to begin the same round again. Supposing now the radiation to space during a clear and calm night to be about the same for different heights, it must freeze, therefore, first in the valley that is filled with the cooler air.

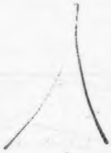
For this circular motion of the air in mountains the early farmer has to settle on their slopes at a mean height, and the settler of the valley must protect himself from the late frosts of May and June. Further, this uprising current is the cause of so many beautiful clear days and nights, especially during the summer months, and the cause of the dry spell.

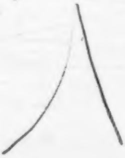
Towards the end of the dry season, the middle of August, the heavy wooded Cœur d'Aléne Mountains begin to smoke—the forests are burning. It is believed that they are set on fire by the lightnings, or by the Indians, more likely.

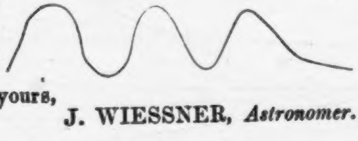
Whilst I was drawing a profile of the road, and by attempting to represent all known heights of the mountains, of settlements and camps along the rivers, in valleys and prairies of Governor (the late lamented General) I. I. Stevens's Northern Pacific Railroad district, between the longitude of the mouth of the Columbia on the west and Fort Union on the east, and within the parallels of 45° and the northern boundary, your signature was found most wonderfully written by the pen of nature: From the Pacific along the Columbia up to Mount Adams, down to the Cascades, up to Mount Hood and down to the Dalles, the profile is an M; along the Columbia, the Walla-Walla, the Touchet to the head of Reed creek, down to the Tukoñon to where Lewis discovered the Snake river, up the Pelouse on to the high plains of the Columbia and down to the St. Joseph, the profile is a U; up the Cœur d'Aléne to Sohon's Pass, and down the St. Regia Borgia to the Bitter Root, the profile is an L; up the Bitter Root, Hell Gate, Little Blackfoot to Mullan's Pass, and down the Little Prickley Pair, the profile is also an L; by the Medicine Rock, Dearborn, Sun river, over the plains to the right of the Teton, to Fort Benton and along the winding Missouri to Fort Union, the profile is an AN.











I remain, sir, very respectfully, yours,

J. WIESSNER, *Astronomer.*

Captain John Mullan, U. S. A.,
Commanding Military Road Expedition.

VOLUME A.

CHRONOMETER COMPARISONS.

Error and rate at New York, April 4, 1859.

Chron.	No.	Maker.	Fast of—	Error.	Daily rates gaining.
				m. s.	s.
Sid.....	525	Eggert & Son.........	N. Y. sid. time.......	+ 2 02.17	1.1
Sol...............	8544	Arnold & Frodsham...	Gr. mean. solar time...	0 45.0	1.9
Sol...............	158	Joseph Dalles.........	.........do.	2 14.5	1.9
Sol..	7961	Arnold & Frodsham...	........do.	+ 0 31.0	1.8

Correction for second hand of the chronometer, 8544.

s. s. s.
From 0 to 14 Correction = 0.0
Do..15 to 40....do...... + 0.4
Do..40 to 43....do...... 0.3
Do..43 to 46....do...... 0.2
Do..46 to 49....do...... + 0.1
Do..50 to 60....do...... 0.0

Correction for second hand of chronometer, 158.

s. s. s.
From 0 to 1 Correction = 0.0
at 2....do...... + 0.2
Do.. 3 to 9....do...... 0.1
Do..10 to 17....do..... 0.2
Do..18 to 23....do...... 0.3
Do..24 to 45....do...... 0.4
Do..46 to 51....do...... 0.2
at 52....do...... 0.3
Do..53 to 55....do...... + 0.2
Do..56 to 60....do...... 0.0

No correction for faces of siderial chronometer 525 and solar chronometer 7961.

Comparison of the chronometers.

The readings are respectively 0, 1, and 2 minutes after the epoch given by the sid.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometers.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No.8544.	No. 158.	No.7961.	
	1859.	h.	m.	h.	m.	s.	h.	m.	s.	h.	m.	s.	°	s.	s.	s.	
At sea	April 5, p. m.	7	24	11	23	55.2	11	26	23.0	11	25	36.1	....	....	....	....	
Steamer St. Louis	6, a. m.	22	00	1	57	33.5	2	00	09.5	1	59	12.0	....	+1.8	+1 0	−0.6	Clear, calm, cold, rough sea.
Do.	7, a. m.	21	40	1	33	43.0	1	36	08.0	1	35	20.0	....	2.1	+0.1	+0.6	Clear, cold.
Do.	8, a. m.	22	19	2	08	43.0	2	11	05.2	2	10	20.0	....	2.3	−0.5	+2.3	Pleasant.
Do.	9, a. m.	22	23	2	08	50.0	2	11	12.3	2	10	19.5	....	3.5	+3.6	−4 0	
Havana	10, a. m	22	43	2	24	52.5	2	27	16.2	2	26	18.0	....	1.7	+3.1	−2.3	Warm.
Do.	....	22	46	2	24	53.0	....			....			....	2.7	....	....	
At sea	11, a. m.	23	44	3	21	50.6	3	24	15.0	3	23	08.1	....	+3.5	+4.7	−4.0	Towards evening removed chronometers into room No. 34, where they stood long ships.
Do.	12, a. m.	23	15	2	48	58.3	2	51	22.0	2	50	10.1	....	−1.1	−1.8	−6.8	
Do.	13, a. m.	23	15	2	45	06.3	2	47	31.5	2	46	15.6	....	+3.9	+5.4	+1.4	Chronometer turned over before comparison. Hot.
Do.	14, a. m.	23	15	2	41	15.0	2	43	40.2	2	42	18.3	....	4.6	4.6	−1.4	Ship rolling considerably.
Do.	15, a. m.	23	15	2	37	22.5	2	39	48.5	2	38	22.3	....	3.4	4.2	−0.1	Bunk got damp.
Aspinwall	16, a. m.	20	26	11	44	57.5	11	47	23.8	11	45	54.3	....	3.2	3.5	+0.2	To Panama by railroad.
At sea	17, a. m.	23	15	2	29	39.3	2	32	00.5	2	30	29.0	....	5.4	0.3	−1.7	Chronometers on floor of bunk.
Steamer I. Stephens	18, a. m.	23	25	2	35	46.3	2	38	11.0	2	36	29.7	....	4.5	8.0	1.8	Placed the chronometers on a shelf.
Do.	19, a. m.	23	42	2	48	52.3	2	51	16.5	2	49	29.8	96.0	4.7	4.2	−1.2	
Do.	20, a. m.	23	45	2	48	00.3	2	50	21.3	2	48	34.0	92.0	4.4	1.2	+0.6	
Do.	21, a. m.	24	11	3	10	05.2	3	12	22.5	3	10	30.6	....	8.1	4.1	+4.3	Sea smooth and glassy.
Do.	22, a. m	24	40	3	35	09.2	3	37	22.7	3	35	27.5	92.0	4.6	0.8	−2 5	
Do.	23, a. m.	23	02	1	53	33.9	1	55	44.0	1	53	45.3	91.0	4.6	+1.2	2.3	
Do.	24, a. m.	1	27	4	14	20.1	4	16	24.0	4	14	23.7	....	5.9	−0.3	1.9	Cooler weather.
Do.	25, a. m.	1	40	4	23	27.1	4	25	26.0	4	23	21.3	....	4.9	0.1	4.5	
Do.	26, a. m.	1	48	4	27	34.7	4	29	27.0	4	27	22.0	....	+4.6	−2.0	−2.3	
Off Cape St. Lucas	Compa	rison		6	39	34.0	with ship's			chronometer			....	....	....	....	6h. 39m 16.0s. Gr. M. T.
Do.	27, a. m.	2	09	4	44	40.3	4	46	25.1	4	44	16.5	63.0	+4 9	−2.6	−6.2	
Do.	28, a. m.	2	31	5	02	45.7	5	04	23.0	5	02	10.7	61.0	4.2	2.3	6.0	
Do.	29, a. m.	2	32	4	59	54.8	5	01	23.0	4	59	07 7	60.0	5.2	3.9	6.9	Rainy.
Do.	30, a. m.	2	46	5	10	01.0	6	11	21.0	5	09	04.3	55.0	4.4	3.8	5.2	
San Francisco	May 1, a. m.	1	31	3	51	21.3	3	52	33.2	3	50	16 0	60.0	+3.9	−4.2	−4.7	Sailing into the harbor.
International Hotel	....	4	38	6	57	51.0	6	59	01.5	6	56	43.8	....	....	....	....	Heavy rain.
Do.	2, a. m.	2	56	5	12	16.7	5	13	19.8	5	10	58.9	....	+5.2	−3.6	−7.3	
				7	52	00.0	....			7	48	41.0					
	Comparison wi	th chron		ometer of Mr.			Th. Tennant.			8	08	10.2	equal	to Gr.	M. T.	....	8h. 08m. 48.6s.
				8	47	00.0	....			8	43	41.0					
Do.	3, a. m.	2	00	4	13	34.2	4	13	20.1	4	11	07.	....	+4.2	−4.0	−4.8	Fine weather.

At sea	4, a. m.	2 56	5 04 34.0	5 06 19.2	5 09 55.4	......	4.9	5.0	6.9	On board the Northerner.
Do.	5, a. m.	3 17	5 21 39.6	5 22 16.6	5 19 50.9	......	+4.3	—3.9	—6.5	
Do.	5, p. m.	12 34	1 30 39.4	1 29 08.6	1 25 54.8	......	......	......	......	
The reading	half minute later are		02.9	38.8	25.0	......	......	......	......	
Do.	6, a. m.	3 12	5 12 50.0	5 13 16.2	5 10 49.6	......	+5.5	—5.1	—5.5	**Humboldt dead.**
Portland.	7, a. m.	3 12	5 08 50.1	5 09 14.8	5 06 49.0	......	5.0	5.5	4.7	Rainy day.
Metropolis Hotel	8, a. m	4 00	5 53 00.0	5 53 06.0	5 50 41.5	......	12.8	5.0	3.7	
Carrie Ladd	9, a. m.	2 34	4 23 21.0	4 23 19.0	4 20 55.4	......	+2.8	—5.2	—4.3	Shaking terribly.
Do.	9, a. m.	5 05	6 53 57.0	6 53 53.8	6 51 30.6	......	......	......	......	
Upper Cascades	9, p. m.	11 58	1 45 49.5	1 45 43.8	1 43 19.0	......	......	......	......	The sidereal fell on the ground.
Do.	9, p. m.	12 02	1 49 48.8	......	......	......	......	......	......	Four minutes later.
Steamer Hassaloe	10, a. m.	3 00	4 45 24.8	1 45 14.3	4 42 50.1	......	+3.9	—4.6	—5.2	
Dalles	11, a. m.	3 43	5 24 26.4	5 24 06.0	5 21 42.0	......	+4.5	—5.4	—5.2	
Do.	11, a, m.	......	9 05 00.0	......	9 00 12.0	......	......	......	......	
Do.	11, p. m	......	1 09 00.0	......	1 04 10.0	......	......	......	......	
Do.	12, a. m.	0 08	1 46 09.2	1 45 41.2	1 43 17.0	......	+3.5	—4 1	—4.3	
On board the Colonel Wright.	13, a. m.	2 55	4 26 05 2	4 25 27.8	......	75.0	......	......	......	
Do.	13, a. m.	3 00	4 31 04.2	4 30 26 2	4 28 00.7	......	—2 40.9	—2 50.9	—2 52.2	Sidereal gained 2m. 46s.
Do.	14, a m	2 58	4 25 13.6	4 24 27.2	4 21 59 0	71.5	+5.0	—3.4	—6.1	
Do.	14, a. m.	......	9 02 00.0	......	8 56 43.0	......	......	......	......	
Do.	15, a. m.	4 02	5 25 11.0	5 24 16.8	5 21 47.5	......	+3.9	—3.9	—5.0	Terrible shaking.
Do.	15, p. m.	16 58	6 19 06.4	6 18 08.0	6 15 37.8	......	......	......	......	
			6 26 00.0	......	6 20 32.0					
Old Fort	16, a. m.	2 35	3 54 33.2	3 53 31.0	3 50 59.1	......	+3.9	—4.1	—6.7	
Walla-Walla	17, a. m.	3 16	4 31 35.8	4 30 23.2	4 27 51.4	68.0	5.4	5.2	5.1	
Bank Walla-Walla river	18, a. m.	23 34	12 46 17.0	12 44 55.8	12 42 25.0	......	+0.7	—7.9	—6.9	
Touchet	18, p. m.	14 10	3 20 27.2	3 19 00.8	3 16 26.4	......	......	......	......	Sidereal gained 30s..
Do.	19, a. m.	1 26	......	2 32 07.2	2 29 33 1	51.0	......	......	......	
Do.	19, a. m.	2 05	3 12 32.0	3 11 00.8	3 08 26.8	......	—24.3	—34.3	—37.5	
New Fort, W. W	20, a. m.	2 40	3 41 59.0	3 40 17.1	3 37 44.2	64.0	—1 31.4	—1 42.1	—1 41.0	Sidereal gained 1m. 35.2s.
Storehouse	20, p. m.	14 12	3 12 08.0	3 10 21.8	3 07 44.9	71.0	......	......	......	
Do.	21, a. m.	2 35	3 33 08.9	3 31 17.0	3 26 36.8	67.0	+4.8	—5.0	—10.3	
			38.5	47.0	08.8	......	......	......	......	Readings ¼ minute later.
Camp	22, a. m.	2 54	3 48 14.0	3 46 13.0	3 43 31.0	......	+4.1	—5.1	—8.9	Box, 62°; air, 71°.
			43.8	42.8	00.8					
Do.	22, p. m.	13 56	2 48 28.0	2 46 22.4	2 43 36.7	......	......	......	......	Basket, 74°.
			58.2	52.2	06.6					
Do.	23, a. m	2 45	3 35 24.8	3 33 13.4	3 30 28.2	......	+5.4	—5.2	—8.4	Basket, 54°; air, 57°.5.
			55.0	43 1	58.0					
Do.	23, p. m.	11 38	0 27 00.0	0 24 43.0	0 21 57.8	......	......	......	......	Basket, 63°.8.
			29.6	13.2	27.8					
Do.	24, a. m.	4 11	4 57 19.2	4 54 51.6	4 52 11.2	......	+4.4	—8.7	—6.9	
			49.4	24.5	41.1					
Do.	24, p. m.	11 30	0 15 09.6	0 12 41.2	0 09 55.2	......	......	......	......	Basket, 66°; air, 72°.
			39.2	11.4						
Do.	25, a. m.	2 22	3 04 45.2	3 02 08.2	2 59 26.4	......	+3.9	—8.4	—6.3	Basket, 44°.5; air, 62.°
			15.0	38.0	57.2					
Do.	25, p. m.	12 22	1 03 09.2	1 00 27.0	0 57 47.4	......	......	......	......	
			38.8	57.4	17 8					
Do.	26, a. m.	4 18	4 56 35.1	4 53 46.4	4 51 09.0	......	+5.1	—6.6	—3.9	
			05.6	16.8	39.0					
Do.	26, p. m.	12 39	1 16 15.2	1 13 23.3	1 10 45.2	......	......	......	......	
			45.2	53.3	15.2					

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No. 8544.	No. 158.	No. 7961.	
	1859.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	°	*s.*	*s.*	*s.*	
Camp.....	May 27, a. m	3	15	3	49	54.8 24.8	3	46	52.9 27.6?	3	44	20.6 50.1	....	+5.1	–3.3	–3.0	
Walla-Walla Observatory...	27, p. m.	....		3	21	00.0	3	55	53.8 23.6	5	20	01.4 31.6	....	....	....	....	Rej.
Do.....................	27, p. m.	13	21	1	54	18.4 48.2	1	51	17.8 47.7	1	48 49	39.4 09.6	....	....	....	....	
Do.....................	27, p. m.	13	28	2	01	17.2 47.4	1	58	16.6 46.6	1	55	38.2 08.4	....	....	....	....	
Do.....................	28, a. m.	3	36	4	07	01.2 30.8	4	03	55.4 24.8	4	01	18.1 48.0	....	+5.5	–2.2	–3.0	
Do..	28, a. m.	3	52	4	22	58.8 28 4	4	19	52.5 22.5	4	17	15.3 45.0	....	....	....	....	
Do.....................	28, p. m.	13	24	1	53	27.2 57.2	1	50	17.5 47.2	1	47	40.0 10.2	....	....	....	....	
Do....	29, a. m.	6	14	6	40	45.0 14.9	6	37	27.9 58.2	6	34	52.2 22.6	....	+5.8	–5.3	–3.9	
Do.....................	29, p. m.	13	56	2	21	30.9 01.1	2	18	11.4 41.0	2	15	35.5 05.6	....	1.7	1.2	1.2	For ½ day.
Do.....................	30, p. m.	13	43	2	04	42.4 12.6	2	01	13.0 42.3	1	58	35.6 05.6	....	5.3	4.8	6.1	
Do.....................	31, a. m.	3	39	3	58	27.6 57.6*	3	54	51.6 21.6	3	52	17.0 46.6	....	+2.1	–4.0	–1.8	½ day's rate. * Rej.
Do..........	31, a. m.	3	51	4	10	25 6 56.0	....			....			....	....	....	....	
Do.....................	June 1, a. m.	5	11	5	26	19.9 50.0	5	22	30.8 01.2	5	20	01.4 31.6	....	+3.3	–9.7	–4.4	
Do.....................	1, p. m.	12	06	0	19	13.7 43.7	0	16	21.6 51.7	0	13	51.4 21.8	....	....	....	....	
Do.....................	1, p. m.	12	20	0	34	11.6 41.2	....			....			....	....	....	....	
Do.....................	1, p. m.	12	21	0	35	11.7 41.2	....			....			....	....	....	....	
Do...	1, p. m.	12	22	0	36	11.1 40.9	....			....			....	....	....	....	
Do.....................	1, p. m.		23	0	37	11.0 40.8	....			....			....	....	....	....	
Do.....................	1, p. m.		24	0	38	11.0 40 7	....			....			....	....	....	....	
Do.....................	2, a. m.	2	40	3	00	53.3	3	56	51.8	2	54	24.2	....	....	....	....	Mean temperature during night, 55°.

Do....................	2, a. m.	2	58	3	09	22.0 50.1 19.8	3	05	22.7 51.8 21.4	3	03	53.8 22.8 52.3	....	....	....	....	Comparison by J. W.
Do....................	2, a. m.	3	05	3	16	49.0 18.8	3	12	50.6 20.5	3	10	21.8 51.5	....	+4.2	—5.1	—4.6	Comparison by Th. K.
Do....................	2, a. m.	3	08	....			3	14	50.2 20.1	......		......	....	....	....	....	
On the road	2, p. m.	....		12	40	00.0	12	34	58.0	12	32	28.2*	....	....	....	....	* To be used for the determination of travelling rate.
Do....................	2, p. m.	....		12	43	00.0	12	37	58.0	12	35	28.2*	....	....	....	....	
Do....................	3, a. m.	....		12	04	00.0	11	58	53 4	11	56	25.0*	....	....	....	....	Comparison before the observation for time.
Old Fort....................	3, a. m.	....		3	55	00.0	3	49	51.4	3	47	24.1*	....	....	....	....	Comparison after the observation for time.
Do....................	3, a. m.	....		5	53	00.0	5	47	50.6	5	45	23.1*	....	....	....	....	Comparison after the observation at noon.
Do....................	3, a. m.	....		8	20	00.0	8	14	49.6	8	12	21.9*	....	....	....	....	
Camp....................	4, a. m.	....		4	56	00.0	11	50	44.3	11	48	15.1*	....	....	....	....	
Observatory....................	4, noon.	8	02	8	05	17.6 47.8	8	00	59.2 28.8	7	58	28.3* 57.9	....	....	....	....	
Do....................	4, p. m.	....		10	35	00.0	10	29	40.0	10	27	09.8	....	....	....	....	
Do....................	5, a. m.	3	09	3	09	13.4 42.9	3	04	47.0 16.9	3	02	17.0 46.6	....	+12.6 4.2	—15.3 5.1	—16.5 5.5	3 days' rate. 1 day's rate.
Do....................	6, a. m.	3	31	3	27	17 3 47.2	3	22	39.9 10.8	3	20	12.0 42.3	....	+3.6	—7.1	—5.1	J. W.
Do....................	6, a. m.	3	37	3	33	16.2 46.5	3	28	39 2 09.3	3	26	10.9 40.6	....	....	....	....	J. W.
Do....................	6, a. m.	3	42	3	38	15.7 45.6	3	33	38.4 08.8	3	31	10.1 39.9	....	....	....	....	Th. K.
Do....................	7, a. m.	4	14	4	07	17.6 37 6	4	02	31.2 01.4	4	00	02.8 32.8	....	+1.6	—7.8	—8.1	J. W.
Do....................	7, a. m.	4	22	4	14	16.5 46.5	4	09	30.2 00 3	4	07	01.3 31.3	....	....	....	....	
Walla-Walla Observatory...	8, a. m.	3	55	3	43	29.8 60.2	3	38	34.3 05.0	3	36	04.0 34 0	....	+5.2	—3.8	—6.0	J. W.
Do....................	8, a. m.	4	00	3	48	29 2 58.8	3	43	34.0 04.0	3	41	03.2 33.0	....	....	....	....	
Do....................	9, a. m.	4	56	4	40	29.5 59.9	4	35	24.3 54.2	4	32	49.5 19.9	....	+5.6	—4.5	—8.4	Th. K.
Do....................	10, a. m.	4	23	4	03	42.8 12.7	3	58	29.7 59.7	3	55	54.1 23.5	....	+3.6	—4.1	—7.2	J. W.
Do....................	10, a. m.	4	29	4	09	41.7 12.0	4	04	28.5 58 8	4	01	52.0 22.2	....	....	....	....	Th. K.
Do....................	11, a. m.	4	44	4	20	47.2 17.0	4	15	25.1 56.8?	4	12	48.0 18 1	....	+3.6	—4.5	—4.7	J. W.
Do....................	12, a. m.	5	08	4	32	52.4 22.0	4	27	22.2 52 2	4	24	44.2 14.6	....	3.6	5.2	5.1	Th. K.
Do....................	13, a. m.	5	00	4	29	00.0 29.6	4	23	19.7 49.8	4	20	42.5 12.5	....	3.5	6.6	6.0	
Do....................	14, a. m.	5	06	4	31	06.6 36.1	4	25	16.6 46.6	4	22 23	40.2 10.2	....	3.4	6.2	5.4	
Do....................	15, a. m.	5	01	4	22	14.3 44.2	4	16	13.9 43.6	4	13	39.1 09.3	....	3.1	7.8	4.9	
Do....................	16, a. m.	4	38	3	55	25.2 55.6	3	49	15.4 45.4	3	46	42.0 12.1	....	+3.2	—6.2	—5.1	

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.	Solar chronometer.			Temperature.	Daily relative rates.			Remarks.
			No. 8544.	No. 158.	No. 7961.		No.8544.	No. 158.	No.7961.	
	1859.	h m.	h. m. s.	h. m. s.	h m. s.	°	s.	s.	s.	
Walla-Walla Observatory....	June 16, p. m.	13 47	1 02 57.6 27.2	1 56 43.6 13.9	0? 54 10.2 40 0	....	....	....	....	
Do....................	17, a. m.	6 07	5 20 19.2 49.4	5 13 59.6 29.2	5 11 26.6 56.2	....	+4.4	−5.5	−5.1	
Do....................	17, p. m.	11 50	11 09 23.9 54.4	10 56 01 2 30.8	10 53 29.1 58.7	....	....	....	....	
Do....................	18, a. m.	6 05	5 14 26.8 56.8	5 07 55.6 25.2	5 05 25.8 55.2	....	+3.1	−8.4	−5 3	
Do....................	19, a. m.	5 19	4 24 41.2 11.6	4 17 59.8 29 3	4 15 32.0 01.6	....	3.0	7.5	5.3	
Do....................	20, a. m.	5 38	4 39 45.0 14.6	4 32 52.2? 22.7	4 30 27.0 56.7	....	+2.4	−8.0	−6.0	Th. K.
Do....................	20, a. m.	5 57	....	4 50 49.0 19.0	....	....	....	....	....	
Do....................	21, a. m.	5 49	4 46 49.0 18.8	4 39 46.6 16.7	4 37 23.0 52.7	....	+1.8	−8.2	−6.2	Do.
		7961			525				525	
Camp....................	22, a. m	5 16	5 27 40.0	5 20 27.6	6 35 50.8	....	....	....	....	J. W.
Do....................	23, a. m.	11 23	11 34 50.0	11 27 29.6	0 45 57.0	....	....	....	....	
Dry creek	24, a. m.	11 38	11 50 02 5	11 42 32.0	1 05 05.5	....	....	....	....	
Touchet	25, a m.	2 19	2 31 16.0	2 23 31 5	3 50 41.0	....	....	....	....	
Reed creek..................	26, p. m.	10 03	10 15 29.1	10 07 26.4	11 40 05.5	....	....	....	....	
Fort Taylor	27, p. m	2 25	2 37 42.1	2 29 25.2	16 06 57.9	....	....	....	....	
Do....................	28, a. m.	1 52	2 04 45.0	1 56 22.8	3 35 54.5	....	....	....	....	
Do....................	29, a. m.	2 58	3 10 58.4	3 02 20.5	4 46 14.0	....	....	....	....	
Do....................	30, a. m.	1 26	1 39 11.5	1 30 19.6	4 18 05.8	....	....	....	....	
		525			7961				7961	
Fort Taylor	July 1, a. m.	2 58	1 17 12.3 42.1	1 08 05.0 34.8	1 05 49.5 19.5	....	....	....	....	

Do........	2, a. m.	2	41	1	56	12.2 41.8	1	40	44.3 14.5	1	44	38.4 08.4	....	....	....	....
Do........	3, a. m.	4	59	3	10	06.8 06.4?	3	00	23.6 53.7	2	58	18.8 48.4	....	....	....	....
Do........	4, a. m.	2	05	0	12	40.0 10.2	0	02	45.8 15.0	0	00	44.5 14.8	....	....	....	....
1st on Palouse........	5, a. m.	2	55	0	58	36.2 06.5	0	47	30.8 59.5	0	46	31.2 00.8	....	....	....	....
2d on Palouse........	6, a. m.	2	11	0	10	49 3 19.0	0	00	30.6 01.3	11	58	29.5 59.5	....	....	....	....
3d on Palouse........	7, a. m.	4	42	2	37	30.8 00.7	2	26	58.0 27.7	2	24	27.7 23.8	....	....	....	....
Do........	8, a. m.	5	00	2	51	30.9 00.6	2	40	46.3 16.3	2	38	42.2 12.5	....	....	....	....
Do........	9, a. m.	7	48	5	35	06.8 36.4	5	24	09.5 39.3	5	22	08.8 38.7	....	....	....	....
4th on Palouse........	10, a. m.	8	52	6	35	02.8 02.3	6	23	52.7 22.5	6	21	53.7 24.2	....	....	....	....
Areteus........	11, p. m.	16	31	2	08	54.0 23.5	1	57	24.8 54.9	1	55	29.8 00.0	....	....	....	....
Tcho-tchou-seepe........	12, p. m.	11	54	9	28	43.2 13.0	9	17	02.4 02.3?	9	15	11.0 40.7	....	....	....	....
Cil-cil-pow-vet-sin........	13, p. m.	20	08	5	37	29.0 58.8	5	25	28.6 58.4	5	23	43.3 13.7	....	....	....	....
Lahtoo........	14, p. m.	18	06	3	31	53.6 23.3	3	19	39.2 09.2	3	17	55.1 25.9	....	....	....	....
Lo-chuls........	15, p. m.	17	20	2	42	06.2 35.5	2	29	38.0 08.2	2	27	59.3 29.0	....	....	....	....
In-chats-chan........	16, p. m.	17	57	3	15	07.0 36.4	3	02	24.7 54.8	3	00	48.6 18.8	....	....	....	....
Do........	17, p. m.	17	42	2	56	17.3 16.8	2	43	21.6 51.3	2	41	49.7 50.5	....	....	....	....
Do........	18, p. m.	17	58	3	08	22.2 52.4	2	55	14.5 44.3	2	53	45.2 15.5	....	....	....	....
Do........	19, p. m.	17	50	2	56	30.2 00.5	2	43	11.8 41.5	2	41	44.8 15.0	....	....	....	....
Do........	20, p. m.	17	45	2	47	38.8 09.2	2	34	10.5 40.2	2	32	43.4 13.4	....	....	....	....
Do........	21, p. m.	19	45	4	43	26.7 57.2	4	29	43.2 *14.5	4	28	13.0 *43.3	....	+3.5	—9.9	—15.6 ....
Do........	22, p. m.	18	20	3	14	47.8 17.7	3	00	54.0 23.6	2	59	22.2 52.0	....	2.8	8.0	9.0
St. Joseph's river, lower camp	23, p. m.	18	20	3	10	54.0 23.5	2	56	46.8 17.0	2	55	15.0 44 6	....	1.9	11.0	11.4
St. Joseph's river, upper camp	24, p. m.	19	57	4	43	44.0 14.2	4	29	24.5 54.8	4	27	58 2 28.8	....	2.2	10.5	4.5
Do........	25, p. m.	19	21	4	03	56.4 26.5	3	49	18.7 48.7	3	48	02 0 32.0	....	2.9	15.0	5.9
Do........	26, p. m	18	31	3	10	10.0 39.6	2	55	16.0 45.8	2	54	07.5 37.2	....	1.1	15.1	7.0
Do........	27, p. m.	19	35	4	10	08.2 37.8	3	54	59.0 28.8	3	53	56.6 26.4	....	+4.6	—10.6	—4.4

* Marked doubtful.

Comparison of the chronometers—Continued.

Place.	Date.		Comparator, sid. chron. 585.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
					No. 8544.			No. 158.			No. 7961.				No. 8544.	No. 158.	No. 7961.	
	1859.		h.	m.	h.	m.	s.	h.	m.	s.	h.	m.	s.	°	s.	s.	s.	
St. Joseph's river, upper camp	July	28, p. m.	17	49	2	20	31.2 01.6	2	05	13 0 42 8	2	04	14.0 43.6	....	+1.9	−7.5	−4.2	
Do....................		29, p. m.	18	43	3	10	28.3 58.5	2	55	00.8 30.0	2	54	05.2 34.8	....	1.7	7.8	4.1	
Do....................		30, p. m.	17	25	1	48	47.0 17.0	1	33	08.6 38.5	1	32	18.5 48.3	....	1.7	8.7	3.5	
Do....................		31, p. m.	16	05	0	25	06.6 36.0	0	09	18.0 47.6	0	08	28.0 57.6	....	2.1	8.0	7.8	
Bridge....................	Aug.	1, p. m.	5	04	1	21	59 6 29.0	1	06	06.0 35.5	1	05	17.0 36.6	....	0.6	4.5	3.4	
Coeur d'Aléne river		1, p. m.	16	46	1	06	05.2 34.8	0	46	07.0 36.8?	0	45	19.5 49.3	....	0.7	3.9	2.4	
Mission		2, p. m.	18	26	2	37	55.2 24.8	2	21	43.6 13 8	2	21	01.0 31.3	....	2.5	11.1	6.2	
Do....................		3, p m.	18	59	3	06	56.4 26 0	2	50	36.0 06.0	2	49	56 6 26.6	....	2.5	6.4	3.2	
Do....................		4, p. m.	18	25	2	29	06.5 36.2	2	12	34.8 35.0	2	11	59.8 29.7	....	0.5	10.8	6.5	
Do....................		5, p. m.	18	43	2	43	09.2 39.0	2	26	25.5 55.7	2	25	58.3 28.3	....	+1.5	10.5	2.6	
Do....................		6, p. m.	17	24	1	20	26.0 56.2	1	03	34.3 04.8	1	03	11.2 40.8	....	0.0	8.1	4.3	
Do....................		7, p. m.	16	57	0	49	34.2 04 4	0	32	32.3 02.9	0	32	15.7 45.5	....	−0.3	10.4	3.9	
Do....................		8, p. m.	17	47	1	35	31.0 01.4	1	18	17.3 47.1	1	18	09.0 38.6	....	+1.0	11.3	2.7	
Do....................		9, p. m.	18	10	1	54	32.0 02.4	1	37	07.5 37.2	1	37	06.6 36.3	....	0.6	10.2	2.7	
Do....................		10, p. m.	18	43	2	23	32.2 02.4	2	05	56.4 26.0	2	06	00.5 30.4	....	1.4	9.9	4 8	
Do....................		11, p. m.	18	26	2	02	39.4 09.5	1	44	53.4 23.2	1	45	03.2 33.0	....	0.3	9.8	4.2	
Do....................		12, p. m.	19	25	2	57	35 2 05.4	2	39	38.8 09.0	2	39	55.0 25.2	....	1.5	8.7	2.3	
Do....................		13, p. m.	18	30	1	58	49.0 19.0	1	40	43.0 13.0	1	41	05.3 35.0	....	0.6	9.0	3.1	
Do....................		14, p. m.	18	46	2	10	51.2 21.0	1	52	35.6 05.5	1	53	03.2 33 0	....	0.6	8.9	3.3	
Do....................		15, p. m.	18	56	2	16	54.0	1	58	26.3	1	59	03 5	....	+0.3	11.8	2.9	

Do..................		16, p. m.	19	11	2	27	23.7 55.5 25.3	2	09	56.3 17.6 47.5	2	10	30.5 01.7 31.6	....	—0.2	10.4	3.6	
Do..................		17, p. m.	19	14	2	26	59.6 29.3	2	08	10.8 40.4	2	09	01.3 31.2	....	+0.5	10.5	4.0	
Do..................		18, p. m.	19	06	2	15	06.2 35.5	1	56	06.2 35.5	1	57	03.5 33.3	....	0.9	10.3	3.3	
Do..................		19, p. m.	19	21	2	26	08.3 38.0	2	06	58.6 28.2	2	08	01.2 31.2	....	0.7	9.0	3.9	
Do..................		20, p. m.	19	04	2	05	15.3 45.1	1	45	57.2 27.0	1	47	04.8 34.7	....	0.3	8.1	3.2	
Do..................		21, p. m.	18	34	1	31	24.4 54.4	1	11	57.3 27.3	1	13	10.2 40.0	....	0.1	8.9	3.7	
Do..................		22, p. m.	18	55	1	48	25.8 56.0	1	28	49.3 19.0	1	30	06.3 36.2	....	+0.9	8.8	4.5	
Do..................		23, p. m.	18	35	1	24	32.6 02.6	1	04	46.4 16.3	1	06	09.5 39.1	....	—0.8	10.2	4.4	
Do..................		24, p. m.	19	35	2	20	26.0 56.2	2	00	31.5 01.2	2	01	58.7 28.6	....	0.8	9.4	4.9	Corr. for index error of thermometer + 9°.6.
Do..................		25, p. m.	19	07	1	48	34.2 04.3	1	28	30.2 00.4	1	30	03.4 33.0	....	0.5	9.7	4.1	
Do..................		26, p. m.	18	57	1	34	39.3 09.2	1	14	26.7 57.2	1	16	05.2 34.8	70.0	—0.7	9.0	4.0	
Do..................		27, p. m.	19	21	1	54	39.5 09.6	1	34	17.8 47.7	1	36	01.0 31.0	69.0	+0.1	9.4	4.2	
Do..................		28, p. m.	18	37	1	06	51.0 20.8	0	46	18.7 48.5	0	48	08.2 37.8	71.0	0.1	10.4	4.3	
Do..................		29, p. m.	19	22	1	47	47.8 17.6	1	27	05.0 34.5	1	28	59.2 29.2	70.0	0.1	10.6	5.4	
Do..................		30, p. m.	18	56	1	17	57.3 27.0	0	57	03.0 32.7	0	59	02.6 32.4	71.5	1.0	10.3	5.1	
Do..................		31, p. m.	18	49	1	07	02.8 32.5	0	45	57.8 27.6	0	48	04.0 33.8	70.0	0.3	10.3	3.8	
Do..................	Sept.	1, p. m.	19	41	1	54	58.7 28.4	1	33	42.3 12.2	1	35	52.6 22.5	68.5	+0.3	11.1	7.0	
Do..................		2, p. m.	19	37	1	47	02.3 32.2	1	25	36.6 06.8	1	27	51.3 21.2	67.0	—1.0	10.3	6.0	
Do..................		3, p. m.	19	56	2	02	03.2 33.1	1	40	26.0 55.8	1	42	48.0 18.0	64.0	+0.1	11.7	4.3	
Do..................		4, p. m.	20	02	2	04	07.6 37.4	1	42	17.7 47.6	1	44	37.5 07.7	62.0	1.3	11.4	13.4	
Do..................		5, p. m.	20	05	2	03	12.2 42.0	1	41	09.4 39.2	1	43	33.0 03.0	61.0	+1.0	11.9	8.2	
Do..................		6, p. m.	19	57	1	51	17.2 47.2	1	29	03.5 33.2	1	31	29.2 58.5	63.5	—0.3	11.3	9.4	
Do..................		7, p. m.	20	22	2	12	17.3 47.2	1	49	52.0 21.8	1	52	20.0 49.7	55.5	0.0	11.5	9.2	
Do..................		8, p. m.	20	35	2	21	19.6 49.7!	2	58	41.2 11.4	2	01	12.5 42.3	....	+0.4	12.6	9.4	Th. Kol.
Do..................		9, p. m.	20	21	2	03	25.7 55.8	1	40	35.5 06.3	1	43	07.8 37.5	51.0	—0.3	12.3	11.2	
Do..................		12, p. m.	19	49	1	19	46.2 16.1	0	56	20.5 50.3	0	58	48.2 18.2	70.0	+2.9	—32.5	—36.9	3 days' rate.

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No. 8544.	No. 158.	No. 7961.	
	1859.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	°	*s.*	*s.*	*s.*	
1 mile east from Mission....	Sept. 13, p. m.	16	57	10	24	19.3 49.5	10	00	43.7 13.7	10	03	10.4 39.8	68.5	+1.0	−9.0	−10.4	
Do....................	14, p. m.	18	22	11	45	10.8 40.5	11	21	24.6 54.5	11	23	51.3 21.5	58.5	+1.1	9.4	8.9	
4.5 miles from Mission......	15, p. m.	19	02	12	21	08.0 37.5	11	57	10.5 40.2	11	59	37.8 08.0	62.0	−0.5	11.6	11.0	
Do....................	16, p. m.	19	26	12	41	08.4 37.6	12	16	58.3 27.8	12	19	32.2 02.2	52.5	+1.1	12.5	5.9	
Do....................	17, p. m.	19	31	12	42	11.8 41.6	12	17	49.5 19.3	12	20	29.9 50.0	53.0	0.4	12 0	6.4	
Do....................	18, p. m.	20	07	1	14	11.4 41.2	0	49	35.0 05.5	0	52	22 5 52.2	60.0	1.7	12.3	4.9	
7.2 miles from Mission......	19, p. m.	20	14	1	17	15.3 45.2	0	52	25.0 55.4	0	55	20.5 50.3	63.0	0.9	13.0	4.9	
9.5 miles from Mission......	20, p. m.	19	56	0	55	22.8 53.0	0	30	19.7 49.7	0	33	21.8 51.4	57.0	0.7	12.5	5.8	
Do....................	21, p. m.	20	01	0	56	26.3 56.5	0	31	10.0 39.5	0	34	20.2 50.0	52.0	+0.2	13.3	4.8	
Do....................	22, p. m.	20	41	1	32	23.0 53.8	1	06	53.3 23.2	1	10	10.8 40.5	47.0	−0.5	14.0	7.0	
11 miles from Mission......	23, p. m	22	00	2	47	15.7 46.0	2	21	26.2 56.0	2	24	56.3 26.2	53.0	+1 2	16.3	5.6	
13.5 miles from Mission.....	24, p. m.	21	00	1	43	29.0 59.6	1	17	25.0 55.3	1	21	01.4 31.5	53.0	−0.5	16.9	8.7	
Do....................	25, p. m.	20	54	1	33	33.8 04.2	1	07	14.6 44.3	1	11	01.3 31.3	53.0	−0.3	15.8	5.2	
16.3 miles from Mission.....	26, p. m.	20	55	1	30	38.7 08.2	1	04	05.0 34.8	1	07	55.8 26.0	51.3	+1.0	13.4	9.3	
Do....................	27, p. m.	20	20	0	51	50.0 19.6	0	25	03.0 32.8	0	28	55.2 25.0	48.0	1.1	11.8	10.6	
Do....................	28, p. m.	20	20	0	47	55.6 25.2	0	20	56.5 26.2	0	24	48.6 18.6	50.5	1 5	10.7	10 6	
Do....................	29, p. m.	20	30	0	53	58.6 28.2	0	26	45.3 15.3	0	30	45.0 15.2	44.6	0.5	13.5	6.0	
20 miles from Mission.......	30, p. m.	21	00	1	19	57.7 27.5	0	52	27.8 58.0	0	56	35.2 05.0	50.0	0.1	16.5	9.2	
Do....................	Oct. 1, p. m.	20	32	0	48	08.3 38.0	0	20	23.8 53.8	0	24	35.7 05.3	55.0	1.6	12.9	8.4	

Do.	2, p. m.	20	02	12	15	18.0 48.2	11	47	20.8 51.2	12	51	37.8 08.1	50.0	1.1	11.8	6.6
Camp 9	3, p. m.	21	35	1	43	08.0 37.5	1	14	52.3 23.2	1	19	15.3 45.1	45.0	+0.5	17.0	11.9
Do.	4, p. m.	18	12	10	16	43.7 13.5	9	48	10.3 39.8	9	52	46.3 46.5	50.0	—1.5	20.4	6.1
Romantick	5, p. m.	20	37	0	37	22.8 53.0	0	08	28.6 58.4	0	13	13.8 43 5	42.3	1.0	21.9	13.1
Sohon's Pass	6, p. m.	22	28	2	24	07.5 37.3	1	54	45.3 15.3	1	59	46.7 17.0	37.0	—3.4	31.1	14.7
Do.	7, p. m.	23	04	2	56	08.2 37.7	2	26	26.8 56.6	2	31	40.2 10.2	43.0	+2.3	16.8	4.8
Do.	8, p. m.	22	02	1	50	23.5 53.5	1	20	24.2 54.3	1	25	50.2 20.3	34.2	+1.4	16.7	4.2
Do.	9, p. m.	22	27	2	11	24.2 54.5	1	41	04.8 34.5	1	46	42.2 12.5	32.0	—1.5	21.8	10.1
Do.	10, p. m.	23	24	3	04	20.3 50.2	2	33	39.5 09.7	2	39	28.2 57.8	31.0	+1.1	19.9	9.2
Do.	11, p. m.	23	51	3	27	22.2 52.3	2	56	21.5 51.0	3	02	20.2 49.8	31.7	0.0	20.4	10.0
Do.	12, p. m.	0	12	3	44	24.2 54.0	3	13	02.3 32.0	3	19	13.7 43.3	27.0	—1.1	22.1	9.5
Do.	13, p. m.	23	36	3	04	34.8 05.0	2	32	48.0 18.0	2	39	15.8 45.6	29.0	+0.8	24.1	7.8
Do.	14, p. m.	23	40	3	04	38.8 09.0	3	32	28.0 58.0	2	39	12.2 42.0	35.0	0.5	23.5	7.1
Do.	15, p. m.	23	03	2	23	50.5 20.3	2	51	22.0 52.0	1	58	16.2 46.0	28.5	1.3	16.2	6.2
Do.	16, p. m.	22	39	1	55	59.5 29.3	1	23	08.3 38.0	1	30	17.6 47.4	24.5	+0.8	22.1	6.8
Do.	17, p. m.	22	57	2	10	01.7 31.3	1	36	46.3 16.2	1	44	11.2 41.0	26.5	—1.4	25.4	9.9
Do.	18, p. m.	24	52	4	00	46.8 16.6	3	27	09.0 38.8	3	34	46.4 16.7	31.0	—0.1	22.6	9.9
Do.	19, p. m.	23	46	2	51	02.2 32.0	2	17	05.3 35.0	2	24	54.0 24.5	35.5	+0.5	18.7	7.2
Do.	20, p. m.	23	30	2	31	08.6 38.2	1	56	48.3 18.2	2	04	51.7 22.0	34.0	—0.6	23.8	9.2
Do.	21, p. m.	24	29	3	26	02.8 32.2	2	51	21.6 51.6	2	59	35.2 05.0	34.0	—0.4	21.1	11.3
Do.	22, p. m.	23	09	2	02	20.2 50.3	1	27	20.2 50.3	1	35	44.5 15.0	38.0	+0.5	18.6	7.6
Do.	23, p. m.	23	05	1	54	25.0 55.2	1	19	03.8 33.5	1	27	40.3 10.8	38.0	+0.1	21.4	8.8
Do.	24, p. m.	23	29	2	14	25.2 56.0	1	38	40.3 10.5	1	47	31.7 01.6	38.7	—1.5	25.7	11.6
Do.	25, p. m.	0	04	2	45	24.8 55.0	2	09	18.8 48.5	1	18	22.5 52.3	39.0	+0.5	20.0	7.5
Do.	26, p. m.	22	24	1	01	45 2 15.0	0	25	17.0 47.0	0	34	35.8 05.7	39.0	—0.3	24.3	7.2
Do.	27, p. m.	21	30	0	12	56.8 26.7	11	36	04.0 33.8	11	45	33.3 03.2	36.5	+0.1	—24.5	—14.0

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No. 8544.	No. 158.	No. 7961.	
	1859.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	°	*s.*	*s.*	*s.*	
Sohon's Pass	Oct. 28, p. m.	21	25	11	55	04.0 33.6	11	17	49.0 18.5	11	27	31.0 00.7	37.0	+0.7	−21.6	− 8.9	
Do	29, p. m.	21	20	11	46	08.8 38.4	11	08	32.0 02.0	11	18	26.2 55.7	35.0	−0.1	−21.6	− 9.6	
Do	30, p. m.	24	06	2	27	43.2 13.0	1	49	38.0 08.0	1	59	48.5 18.5	34.0	......	......	......	
Do	30, p. m.	1	30	3	51	29.0 59.2	3	13	— 52.2	3	23	34.0 04.0	35.0	......	......	......	
Do	31, p. m.	21	11	11	20	16.0 46.2	10	50	50.2 50.0	11	01	12.3 42.1	37.5	− 1.1	−25.8	−11.7	
12 miles from Pass	Nov. 1, p. m.	0	24	2	37	47.0 17.0	1	58	54.2 24.5	2	09	33.0 03.0	34.0	1.6	28.3	11.7	
27 miles from Pass	2, p. m.	0	15	2	23	42.3 12.2	1	44	25.4 55.7	1	55	18.8 48.5	34.2	− 1.4	−25.4	−11.0	Sid. + 1m. 09s.
Do	2, p. m.	0	45	2	53	37.5 07.5	......	......	......	......	......	......	......	......	......	......	
Mouth of St. Regis Borgia	3, p. m.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	No. compar.
Bitter Root Observatory	4, p. m.	22	23	0	24	03.8 33.6	11	43	51.6 21.3	11	55	21.2 50.7	36.3	− 2.5	−30.3	−12.2	
Do	5, p. m.	22	33	0	30	03.7 33.5	11	49	19.0 49.2	0	01	11.3 41.0	27.5	2.6	34.8	12.3	
Do	6, p. m.	21	05	10	56	18.8 48.7	10	17	14.5 44.3	10	29	19.8 49.5	32.0	3.4	23.2	10.0	
Do	7, p. m.	23	10	1	07	59.5 29.2	0	26	29.7 59.7	0	38	50.2 20.5	25.5	1.5	26.8	11.4	
Do	8, p. m.	0	39	2	23	46.7 16.5	1	41	49.4 19.5	1	54	29.2 59.0	26.0	3.7	31.3	12.2	
Do	9, p. m.	1	09	2	40	42.7 12.8	2	07	21.0 51.5	2	20	16.0 45.8	17.5	3.1	27.4	12.4	
Do	10, p. m.	1	10	2	46	36.[illegible] [illegible].8	2	03	35.5 05.6	2	17	05.4 35.3	10.5	10.7	49.6	14.5	
Do	11, p. m.	2	00	3	32	20.0 50.0	2	48	42.2 12.4	3	02	43.5 13.7	1.5	11.8	49.1	17.6	
Do	12, p. m.	2	17	3	44	40.3 10.3	3	00	28.2 58.3	3	15	26.8 56.6	2.8	41.1	75.5	18.3	
Do	13, p. m.	0	59	2	29	43.0 13.0	1	37	38.2 08.3	1	53	25.4 55.2	15.0	14.2	66.9	18.3	
Do	14, p. m.	2	19	2	31	28.8 58.9	2	45	50.0 19.8	3	01	59.2 29.0	27.0	9.1	40.4	19.3	

Do....................		15, p. m.	1	29	2	44	30.8 00.8	1	58	30.2 00.5	2	14	55.0 24.8	29.5°	6.4	30.7	15.3	
Do....................		16, p. m.	1	29	2	40	29.2 59.3	1	54	04.7 34 4	2	10	44.8 15.0	30.6	5.6	29.9	14.1	
Do....................		17, p. m	1	35	2	42	20.2 50.0	1	55	38.0 08.0	2	12	35.5 05.3	30.0	3.2	29 6	12.6	
Do....................		18, p. m.	2	01	3	04	25.2 55.5	2	17	07.3 37.0	2	34	21.0 50.8	33.0	3.6	—30.8	—14.4	
Do....................		21, p. m.	20	26	9	18	26.2 56.4	8	15	48.5 18.5	6	39	14.6 44.4	31.5	6.3	....	....	Chronometers 158 and 7961 run off.
Do....................		22, p. m.	20	58	9	46	21.2 51.3	8	42	14.2 44.0	7	07	16.5 46.2	25.8	4.0	—93.3	+ 2.9	
Do....................		23, p. m.	21	02	9	46	18.2 48.3	8	41	37.0 07.3	7	07	16.5 46.2	19.3	6.4	40.4	— 3.4	
Do....................		24, p. m.	21	11	9	51	14.0 43.8	8	45	59.5 29.0	7	12	18.7 48.5	20.5	6.9	40.5	0.3	
Do....................		25, p. m.	21	08	9	44	10.7 40.3	8	38	28.2 58.0	7	05	15.8 45.5	22.3	8.0	35.7	7.6	
Do....................		26, p. m.	21	10	9	42	08.0 37.5	8	35	58.5 28.2	7	03	12.0 42.0	21.2	6.6	33.6	7.4	
Do....................		27, p. m.	21	38	10	06	00.2 29.8	8	59	22.7 52.5	7	27	06.8 36.6	21.8	7.2	35.2	4.8	
Do....................		28, p. m	21	24	9	47	55.0 24.8	8	40	37.8 —	7	09	09.7 39.4	15 3	11.4	51.2	3.5	
Do....................		29, p. m.	22	07	10	28	42.0 12.0	9	18	46.8 17.0	7	48	01.5 31.8	27.3	10.0	47.9	5.0	
Do....................		30, p. m.	22	25	10	40	36.2 06 5	9	32	17.3 47.2	8	01	57.0 27.3	23.5	6.8	30.8	5.6	
Do....................	Dec.	1, p. m.	23	02	11	13	23.7 53.7	10	04	28.5 58.4	8	34	47.3 17.3	10.0	10.6	46.8	7.8	
Do....................		2, p. m.	23	53	0	00	08.5 38.3	10	50	20.0 50.0	9	21	34.5 04.3	13.5	11.0	64.1	8.6	
Do....................		3, p. m.	21	03	9	06	31.7 01.8	7	56	16.2 46.0	6	27	56.5 26.5	23.5	8.5	35.8	9.8	
Do....................		4, p. m.	22	18	10	17	11.3 41.2	9	06	14.8 44.7	7	38	47.0 17.3	1.5	—12.4	—53.2	— 1.2	
Do....................		5, p. m.	....	....	....	....	..	....	....	....	....	....	....	—18.0	.... ..	....	....	8544 froze.
Do....................		6, p. m.	23	22	10	20	00.8 30.5	9	57	27.6 57.6	8	34	18.3 48.0	—13.0	....	—294.6	—36.5	8544 set.
Do....................		7, p. m.	22	52	9	45	52.5 22.2	9	22	14.5 44.3	8	00	21.5 51.3	5.5	—17 3	82.2	5.7	
Do....................		8, p. m	22	27	9	16	47.2 17.2	8	52	12.7 42.4	7	31	18.0 47.5	30.8	13.5	70.1	11.9	
Do....................		9, p. m	22	27	9	12	41.7 11.6	8	47	38.5 08.5	7	27	14.2 43.8	29.0	9.7	38.1	7.8	
Do....................		10, p. m.	22	37	9	18	34.2 04.2	8	53	02.7 32.3	7	33	10.8 40.4	25.5	9.9	38.5	5.9	
Do....................		11, p. m.	22	25	9	02	30.0 00.3	8	36	28.7 58.8	7	17	08.0 37.6	21.8	10.1	39 8	8.8	
Do....................		12, p. m.	23	16	9	49	15.3 45.2	9	22	34.2 04.0	8	03	56.8 26.8	19.3	10.6	50.3	6.7	
Do....................		13, p. m.	23	16	9	45	08.3 38.0	9	17	37.0 07.0	7	59	52.3 22.2	15.5	—11.2	—61.2	— 8.7	

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 325.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No.8544	No. 158.	No.7961.	
	1859.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	°	*s.*	*s.*	*s.*	
Bitter Root Observatory	Dec. 14, p. m.	23	32	9	56	57.2 26.5	9	08	32.7 03.0	8	11	45.7 16.0	14.0	—12.3	—65.7	— 7.9	
Do.	15, p. m.	23	26	9	48	51.2 20.8	9	10	40.6 10.7	8	03	42.5 12.5	24.0	11.0	56.9	8.0	
Do.	16, p. m.	23	00	9	16	50.5 20.3	8	47	07.0 36.7	7	31	43.0 13.0	33.8	9.3	42.5	8.2	
Do.	17, p. m.	22	23	8	35	52.2 21.8	8	05	36.3 06.3	6	50	45.5 15.5	35.7	8.5	40.6	7.6	
Do	18, p. m.	23	43	9	51	29.0 59.2	9	20	37.3 07.5	8	06	29.5 59.3	17.7	13.9	49.9	7.1	
Do.	19, p. m.	1	23	11	26	50.5 20.3	10	55	14.8 44.7	9	42	04.2 34.2	15.0	17.5	70.5	13.0	
Do.	20, p. m.	2	20	12	19	38.2 08.5	11	47	02.0 31.5	10	34	47.5 17.3	12.0	16.9	68.8	12.6	
Do.	21, p. m.	0	19	10	14	47.0	9	41	34.2	8	29	57.0	16.5	15.3	51.5	14.4	Comp. by J. Culligan.
Do.	22, p. m.	0	15	10	06	37.0	9	32	37.0	8	21	49.0	15.5	14.7	61.9	12.7	Do. do.
Do.	23, p. m.	0	22	10	09	19.0	9	34	31.0	8	24	40.0	13.0	21.1	69.1	12.1	Do. do.
Do.	24, p. m.	0	31	10	14	02.5	9	38	27.5	8	27	32.8	17.3	19.1	66.1	9.8	Do. do.
Do.	25, p. m.	0	42	10	20	52.0	9	44	44.0	8	36	25.0	26.0	11.8	44.8	9.1	Do. do.
Do.	26, p. m.	0	45	10	19	45.0	9	43	10.5	8	35	21.5	23.5	10.6	37.1	7.1	Do. do.
Do.	27, p. m.	0	15	9	45	42.0	9	08	32.0	8	01	24.0	19.8	12.0	47.5	6.5	Do. do.
Do.	28, p. m.	0	27	9	53	29.0	9	15	36.0	8	09	18.5	14.5	15.1	58.1	7.6	Do. do.
Do.	29, p. m.	2	06	11	28	03.2 32.5	10	49	29.5 59.7	9	43	56.3 26.3	15.0	14.0	54.3	10.4	Comp. by J. Wiessner.
Do.	30, p. m.	1	23	10	40	58.8 28.5	10	01	52.3 52.9	8	57	05.0 34.8	19.0	15.4	48.5	2.5	
Do.	31, p. m.	22	31	7	45	15.7 45.5	7	05	38.3 08.3	6	01	34.5 64.7	25.0	15.2	46.1	2.5	
	1860.																
Do.	Jan. 1, p. m.	1	02	10	11	35.5 05.5	9	31	09.5 39.2	8	28	08.8 38.4	16.5	19.5	69.4	5.4	
Do.	2, p. m.	23	46	8	51	39.6 09.6	8	10	41.2 11.2	7	08	20.0 50.0	23.5	12.4	44.6	5.1	
Do.	3, p. m.	0	03	9	04	30.2 00.5	8	23	06.3 35.8	7	21	18.7 48.7	28.0	9.6	35.5	1.6	
Do.	4, p. m.	1	26	10	23	11.0 40.8	9	41	19.7 49.5	8	40	06.3 36.0	27.5	9.9	36.9	3.1	
Do.	5, p. m.	1	58	10	51	09.3 39.8	10	08	43.7 13.6	9	00	01.2 31.3	26.0	9.9	38.0	3.9	

Do........................		6, p. m.	1	15	10	04	01.5 31.2	9	21	19.6 49.5	8	21	00.0 30.6	26.3	9.0	35.9	3.5	
Do........................		7, p. m.	0	14	8	59	06.5 36.0	8	16	00.3 30.0	7	16	18.2 48.0	26.2	9.9	33.5	4.8	
Do........................		8, p. m.	0	13	8	54	00.2 29.5	8	10	23.2 53.0	7	11	16.3 46.2	25.0	10.2	41.3	6.2	
Do........................		9, p. m.	0	17	8	53	51.8 21.5	8	09	46.8 16.6	7	11	14.0 43.8	18.0	12.1	39.8	5.7	
Do........................		10, p. m.	0	21	8	53	27.8 58.2	8	08	54.0 23.8	7	11	13.2 43.0	10.5	27.0	56.2	4.2	
Do........................		11, p. m.	0	11	8	39	07.2 36.8	7	53	50.0 20.0	6	57	16.0 45.6	10.5	26.7	69 6	3.0	
Do........................		12, p. m.	0	51	9	14	50.2 20.0	8	28	58.8 28.8	7	33	08.8 38.5	20.5	14.5	48 8	4.8	
Do........................		13, p. m.	0	30	8	58	44.4 45.0	8	12	27.3 57.5	7	17	10.4 40.2	27 0	11.5	37.5	4.4	
Do........................		14, p. m.	1	33	9	48	29.5	9	01	46.0	....			34.0	10.5	36.7	....	
Do........................		15, p. m.	0	20	8	31	40.0	7	44	35.0	....			44.5	5.5	27.0	....	
Do........................		16, p. m.	0	44	8	51	33.5	8	04	05.0	....			43.0	5.8	29.3	....	
Do........................		17, p. m.	0	32	8	35	31.0	7	47	37.5	....			27.0	8.6	33.6	....	
Do........................		18, p. m.	0	33	8	32	21.5	7	43	49.5	....			23.0	18.4	58.9	....	
Do........................		19, p. m.	0	44	8	39	09.5	7	50	06 0	....			26.0	14.3	36.8	....	
Do........................		20, p. m.	0	22	8	20	06.5	7	30	36.5	....			27.0	12.0	36.5	....	
Do........................		21, p. m.	1	01	8	47	57.5	7	58	02.0	....			30.0	7.9	33.4	....	
Do........................		22, p. m.	0	12	7	55	09 8	7	04	44.3	....			31.0	6.8	29.8	....	
Do........................		23, p. m.	0	16	7	51	57.5	7	04	17.5	....			27.0	8.7	30.2	....	
Do........................		24, p. m.	0	44	8	18	48 5	7	27	39.0	....			27.0	8.5	38.0	....	
Do........................		25, p. m.	0	40	8	10	41.0	7	18	56.5	....			27.0	12.3	47.3	....	
Do........................		26, p. m.	0	45	8	11	26.5	7	19	08.0	....			18.0	17.7	51.7	....	
Do........................		27, p. m.	0	49	8	11	07.4 36.0	7	18	12.0 41.5	....			13.5	23.1	59.6	....	
Do........................		28, p. m.	0	49	8	06	52.0 21.5	7	13	19.5 49 0	....			17.5	19.1	56.6	....	
Do........................		29, p. m.	2	09	9	22	21.5 51.7	8	28	15.7 45.6	7	43	36.2 06.2	31 0	21.1	54.6	1.55	
Do........................		30, p. m.	2	07	9	16	09.8 39.5	8	21	33.0 03.3	7	37	33.2 03.2	20.5	16.4	46.9	7.3	
Do........................		31, p. m.	2	25	9	29	54.3 24.0	8	34	42.7 12.6	7	51	27.2 57.0	24.0	15.6	50.6	6.2	
Do........................	Feb	1, p. m.	3	02	10	02	36.4 06.5	9	06	54.3 23.7	8	24	16.2 46.3	33.0	15.8	46.7	—9.0	
Do........................		2, p. m.	2	17	9	13	37.2 07.3	8	17	27.5 57.7	....			35.3	10.6	37.8	....	7961 sent to cantonment Jordan.
Do........................		3, p. m.	2	21	9	13	30.7 01.0	8	16	56.0 25.5	....			29.0	9.9	35.4	....	
Do........................		4, p. m.	2	22	9	10	25.0 55.2	8	13	22.5 52.5	....			33.2	9.6	37.1	....	
Do........................		5, p. m.	2	26	9	10	18.7 48.7	8	12	51.0 20.8	....			36.0	9.9	35.1	....	
Do........................		6, p. m.	2	47	9	27	10.0 39.5	8	29	15.7 45.5	....			39.2	8.6	34.9	....	
Do........................		7, p. m.	4	36	11	11	45.2 15.2	10	13	23.3 53.2	....			31.5	—10.9	—36.8	....	7961 returned but broken.

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometers.							Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.		No 8544.	No. 158.	No. 7961.	
	1860.	h.	m.	h.	m.	s.	h.	m.	s.	h. m. s.	°	s.	s.	s.	
Bitter Root Observatory	Feb. 8, p. m.	2	43	9	14	59.0 28.6	8	16	13.3 43.2	....	30.3	—9.1	—32.6	....	
Do	9, p. m.	2	43	9	10	52.3 22.2	8	11	33.8 04.0	....	24.0	10.6	43.4	....	
Do	10, p. m.	2	51	9	14	45.2 15.2	8	14	55.4 55.0	....	36.5	9.8	41.5	....	
Do	11, p. m.	3	45	10	04	30.7 01.0	9	04	15.0 44.8	....	31.5	9.6	35.5	....	
Do	12, p. m.	3	00	9	15	33.7 03.8	8	14	53.3 22.8	....	37.0	8.5	33.3	....	
Do	13, p. m.	3	05	9	16	27.8 58.0	8	15	20.7 50.8	....	37.0	9.2	35.6	....	
Do	14, p. m.	3	09	9	16	22.0 52.2	8	14	47.3 17.4	....	32.5	9.1	36.8	....	
Do	15, p. m.	3	23	9	26	14.3 44.2	8	24	14.7 44.5	....	36.0	8.6	33.4	....	
Do	16, p. m.	3	20	9	19	09.5 39.3	8	16	46.3 16.2	....	39.5	9.4	33.0	....	
Do	17, p. m.	3	23	9	18	03.8 33.5	8	15	16.9 46.7	....	43.0	9.4	33.0	....	
Do	18, p. m.	3	34	9	24	56.7 26.4	8	21	46.2 15.7	....	36.0	8.3	32.1	....	
Do	19, p. m.	3	29	9	15	52.2 22.0	8	12	17.8 47.8	....	34.0	9.3	33.0	....	
Do	20, p. m.	3	01	8	43	51.3 21.2	7	39	51.2 21.2	....	29.5	9.6	35.3	....	
Do	21, p. m.	2	10	7	48	54.5 24.0	6	44	27.8 57.5	....	28.0	9.4	36.0	....	
Do	22, p. m.	2	47	8	21	40.0 10.2	7	16	34.2 04.2	....	27.3	12.1	51.5	....	
Do	23, p. m.	2	46	8	16	30.7 01.0	7	10	58.0 27.5	....	32.0	13.7	40.8	....	
Do	24, p. m.	2	22	7	48	28.3 58.3	6	42	25.0 55.0	....	33.0	10.6	40.8	....	
Do	25, p. m.	1	34	6	56	29.0 59.2	5	50	03.0 32.7	....	32.0	11.2	34.2	....	525 upset in bed.
Do	26, p. m.	1	43	7	01	22.7 53.0	5	54	30.0 00.2	....	34.0	8.9	35.3	....	
Do	27, p. m.	2	44	7	58	06.7 36.3	6	50	46.0 16.0	....	36.3	11.5	39.3	....	

Do....................	28, p. m.	2 07	7 17 07.0 36.5	6 00 16.2 46.2	....	31.5	9.9	39.9	....
Do....................	29, p. m.	2 17	7 23 00.3 30.0	6 14 42.9 12.2	....	29.0	9.0	36.4	....
Do....................	March 1, p. m.	1 04	6 06 07.7 37.3	4 57 25.0 55.3	....	31.5	8.6	33.1	....
Do....................	2, p. m.	6 17	11 14 09.2 39.0	10 04 53.3 23.2	....	27.5	11.9	44.7	....
Do....................	3, p. m.	2 14	7 07 44.2 14.0	5 58 07.7 37.3	....	31.0	8.9	29.6	....
Do....................	4, p. m.	1 21	6 10 47.7 17.5	5 00 45.5 15.5	....	28.7	9.2	34.7	....
Do....................	5, p. m.	1 31	6 16 39.3 09.2	5 06 10.7 40.3	....	28.0	10.8	37.4	....
Do....................	6, p. m.	0 58	5 39 39.5 09.5	4 28 37.8 08.0	....	27.8	9.2	43.1	....
Do....................	7, a. m.	0 46	5 23 35.8 06.2	4 12 07.2 37.0	....	25.3	9.5	36.8	....
Do....................	8, p. m.	1 25	5 58 23.0 53.4	4 46 28.5 58.5	....	27.5	10.6	36.4	....
Do....................	9, p. m.	2 40	7 09 04.8 34.4	5 56 41.2 11.4	....	33.0	10.4	39.0	....
Do....................	10, p. m.	1 16	5 41 12.8 42.7	4 28 — 56.3	....	28.3	9.7	33.0	....
Do....................	11, a. m.	23 39	4 00 22.5 53.0	2 47 13.0 43.3	....	26.3	10.0	33.0	....
Do....................	12, a. m.	0 46	5 03 05.4 35.0	3 49 29.0 59.3	....	26.8	10.6	37.1	....
Do....................	13, p. m.	2 08	6 20 44.5 14.3	5 06 43.7 13.8	....	34.3	11.5	36.1	....
Do....................	14, p. m.	1 49	5 57 41.2 11.3	4 43 12.6 42.2	....	34.5	10.4	38.5	....
Do....................	15, p. m.	1 57	6 01 33.0 03.4	4 46 39.3 09.0	....	33.7	10.7	36.0	....
Do....................	16, p. m.	1 56	5 56 26.7 56.8	4 41 06.3 06.0	....	34.5	10.8	37.3	....
Do....................	17, p. m.	3 02	6 58 09.9 38.7	5 42 20.7 51.0	....	28.7	11.1	38.6	....
Do....................	18, p. m.	3 43	7 34 54.7 24.3	6 18 41.3 11.7	....	29.2	11.9	35.8	....
Do....................	19, p. m.	2 16	6 04 03.5 33.2	4 47 20.8 50.7	....	25.5	8.9	37.5	....
Do....................	20, p. m.	1 55	5 38 59.8 29.5	4 21 43.7 14.0	....	27.8	11.2	44.4	....
Do....................	21, p. m.	1 59	5 38 51.7 21.4	4 21 08.5 38.3	....	29.3	11.6	39.0	....
Do....................	22, p. m.	2 41	6 16 37.5 07.5	4 58 23.5 53.5	....	30.0	11.4	42.2	....
Do....................	23, p. m.	3 50	7 21 18.0 48.0	6 02 35.3 05.5	....	29.5	12.3	40.9	....
Do....................	24, p. m.	1 49	5 16 30.8 01.5	3 57 23.5 53.7	....	32.5	—10.7	—35.7	....

Comparison of the chronometers—Continued.

Place.	Date.		Comparator, sid. chron. 525.		Solar chronometers.									Temperature.	Daily relative rates.			Remarks.
					No. 8544.			No 158.			No. 7961.				No.8544.	No. 158.	No.7961.	
	1860.		h.	m.	h.	m.	s.	h.	m.	s.	h.	m.	s.	°	s.	s.	s.	
Bitter Root Observatory.....	Mar.	25, p. m.	1	45	5	08	25.0 55.2	3	48	48.2 18.0	...	....		35.0	--10.9	—40.3	....	
Do..................		26, a. m.	0	30	3	49	30.3 00.5	2	29	27.0 57.2	....			31.5	11.0	37.3	....	
1st Camp..................		27, a. m.	22	10	1	25	46.2 45.8	0	05	20.3 50.2	....			22.5	11.4	33.8	....	7 miles from observatory.
2d Camp..................		28, a. m.	22	21	1	32	36.5 07.0	0	11	43.5 13.5	....			28.5	11.5	39.0	....	24 miles from observatory.
3d Camp..................		29, a. m.	22	12	1	19	20.5 51.0	11	58	00.3 29.7	....			29.7	21.4	40.0	....	43 miles from observatory.
4th Camp..................		30, a. m.	22	16	1	19	13.7 43.5	11	57	23.3 53.3	....			29.0	10.7	40.2	....	61 miles from observatory.
Hell Gate..................		31, a. m.	23	18	2	16	56.3 26.0	0	54	34.0 04.2	....			34.0	11.3	43.1	....	72 miles from observatory.
Do..................	April	1, a. m.	23	58	2	52	44.3 14.3	1	29	49.5 19.3	....			29.0	9.6	42.4	....	
Do..................		2, a. m.	0	06	2	56	37.7 08.0	1	32	10.2 40.0	....			26.0	9.1	42.0	....	
Do..................		3, a. m.	2	34	5	20	07.5 37.3	3	56	10.0 39.5	....			24.0	10.4	40.2	....	
Do..................		4, a. m.	3	51	6	32	50.5 20.3	5	08	08.8 38.7	....			20.7	8.5	52.5	....	
Do..................		5, a. m.	2	05	4	43	04.2 33.8	3	17	48.0 18.0	....			22.0	7.9	42.3	....	
Do..................		6, a. m.	3	49	6	22	41.2 11.0	4	56	48.7 18.7	....			22.5	10.0	46.4	....	
Do..................		7, a. m.	2	19	4	48	51.3 21.0	3	22	26.0 56.2	....			25.0	8.1	40.8	....	
Do..................		8, a. m.	2	41	5	06	42.7 12.8	3	39	44.7 14.6	....			26.0	8.9	41.9	....	
Do..................		9, a. m.	2	43	5	04	36.7 06.8	3	37	06.3 36 0	....			28.0	9.8	42.3	....	
Do..................		10, a. m.	3	21	5	38	23.5 53.6	4	10	21.2 51.1	....			35.3	11.1	42.9	....	
Do..................		11, a. m.	2	52	5	05	22.8 52.9	3	36	49.2 19.1	....			24.5	9.5	40.8	....	
Do..................		12, a. m.	3	27	5	36	10.6 40.3	4	07	05.0 04.7	....			36.0	10.8	42.7	....	
Do..................		13, a. m.	4	05	6	09	59.3 29.1	4	40	27.3 57.2	....			45.	9.9	35.5	....	

Do....................		14, a. m.	2 58	4 59	07.2 36.5	3 22	11.2 41.0	....	45.8	7.4	31.3	....
Do....................		15, a. m.	4 41	6 37	45.2 15.2	5 07	23.5 53.3	....	37.2	9.0	35.0	.....
Do....................		16, a. m.	3 40	5 32	52.2 22.0	4 01	59.8 29.5	....	37.0	7.2	37.8	....
Do....................		17, a. m.	4 38	6 26	38.9 08.5	4 55	18.2 48.0	....	44.5	8.2	36.1	....
Do....................		18, a. m.	0 16	2 01	19.0 49.3	0 29	36.8 07.3	....	28.3	6.2	28.0	....
Do....................		19, a. m.	0 39	2 20	12.7 42.3	0 47	57.8 27.4	....	24.5	7.0	39.8	....
Do....................		20, a. m.	1 10	2 47	03.8 33.5	1 14	17.2 47.0	....	28.5	7.8	39.5	....
Do....................		21, a. m.	1 43	3 15	54.7 24.3	1 42	39.5 09.7	....	34.0	7.9	36.2	....
Do....................		22, a. m.	0 22	1 51	05.0 34.7	0 17	23.8 54.0	....	28.0	7.0	33.1	....
Do....................		23, a. m.	0 42	2 06	58.0 27.5	0 32	42.2 12.4	....	22.0	7.9	42.4	....
Do....................		24, a. m.	0 51	2 11	52.6 22.3	0 37	10.2 40.0	....	24.5	8.0	34.9	....
Do....................		25, a. m.	1 00	2 16	46.7 16.7	0 41	35.0 05.3	....	31.5	8.5	37.6	....
Do....................		26, a. m.	1 42	2 54	36.3 06.5	1 18	59.0 28.7	....	34.5	7.5	33.5	....
Do....................		27, a. m.	1 43	2 52	32.8 03.2	1 16	32.0 02.3	....	37.5	7.2	30.5	....
Do....................		28, a. m.	1 43	2 48	29.7 00.3	1 11	04.2 33.9	....	27.3	7.3	32.4	....
Do....................		29, a. m.	2 14	3 14	20.7 51.0	1 37	17.2 47.0	....	30.8	8.0	45.9	....
Do....................		30, a. m.	1 35	2 31	23.5 53.5	0 53	50.0 49.8	....	29.8	7.9	37.7	....
Do....................	May	1, a. m.	0 38	1 30	28.6 58.8	11 52	31.0 01.3	....	37.5	8.2	32.1	....
Do....................		2, a. m.	2 58	3 46	00.3 30.0	2 07	28.5 59.0	....	35.2	9 7	43.6	....
Do....................		3, a. m.	1 19	2 03	12.2 42.0	0 24	13.2 43.0	....	33.8	8.4	36.0	....
Do....................		4, a. m.	1 03	1 43	09.8 39.7	0 03	43.3 13.5	....	40.5	9.0	36.4	....
Do....................		5, a. m.	5 58	6 33	14.3 44.3	4 53	11.2 41.6	....	30 2	11.3	47.8	....
Do....................		6, a. m.	4 24	4 55	24.3 55.0	3 14	49.7 19.5	....	27.5	9.1	41.3	....
Do....................		7, a. m.	2 21	2 48	39.8 10.2	1 07	34.2 04.3	....	28.7	8.9	27.5	....
Do....................		8, a. m.	2 26	2 49	32.0 02.2	1 07	59.5 29.0	....	35.5	11.2	38.3	....
Do....................		9, a. m.	3 57	4 16	11.0 40.7	2 34	04.2 33.7	....	33.5	—10.5	—44.6	....

Comparison of the chronometers—Continued.

Place.	Date.		Comparator, sid. chron. 525.		Solar chronometers.							Temperature.	Daily relative rates.			Remarks.
					No. 8544.			No. 158.			No. 7961.		No. 8544.	No. 158.	No. 7961.	
		1860.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h. m. s.*	°	*s.*	*s.*	*s.*	
Hell Gate	May	10, a. m.	23	28	11	43	50.3 20.0	10	01	16.7 46.5	... .	37.5	—8.9	—35.6	....	
1st Camp		11, a. m	23	58	0	09	38.0 08.3	10	26	24.6 55.0	....	31.3	11.2	51.0	....	13 miles from observatory.
2d Camp		12, a. m.	3	33	3	39	51.2 21.0	1	55	56.7 26.3	....	31.0	17 1	57.3	....	35 miles from observatory.
3d Camp		13, a. m.	0	55	0	58	11.5 41.3	11	13	44.7 14.7	....	23.7	9.6	41.7	....	44 miles from observatory.
4th Camp, Stevens's Prairie		14, a. m.	2	29	2	27	44.6 14.5	0	42	32.5 02.5	....	26.5	15.6	61.0	....	60 miles from observatory.
5th Camp, Casmatlo		15, a m.	1	11	1	05	49.2 19.0	11	19	59.0 28.7	....	28.0	12.3	51.4	....	79 miles from observatory.
6th Camp, Lander's Fork		16, a. m.	0	44	0	34	46.8 16.5	10	48	23.0 53.3	....	28.0	10.9	44.2	....	85 miles from observatory.
7th Camp		17, a. m.	0	22	0	08	41.2 11.3	10	21	42.8 12.8	....	24.0	13.1	48.1	......	106 miles from observatory.
8th Camp		18, a. m.	1	01	0	43	25.8 55.8	10	55	50.7 20.7	....	29.5	13.2	49.8	....	122 miles from observatory.
9th Camp, Father Oken		19, a. m.	1	00	0	38	19.2 49.3	10	50	08.6 38.8	....	47.0	10.8	46.2	....	141 miles from observatory.
10th Camp, Sun River		20, a. m	0	23	11	57	16.5 46.5	10	08	26.5 56.5	....	32.5	12.9	52.4	....	161 miles from observatory.
11th Camp, Springs		21, a. m.	0	34	0	03	27.8 18.0	10	13	56.5 26.3	....	29.5	51.0	92.5	....	185 miles from observatory.
12th Camp, Fort Benton		22, a. m.	2	59	2	23	53.5 22.8	0	33	37 7 07.7	....	41.5	15.0	59.1	....	209 miles from observatory.
Do		23, a. m.	5	31	4	51	23.8 54.0	3	00	31.3 01.5	....	48.0	8.8	45.6	....	
Do		24, a. m.	2	11	1	27	52.4 22.2	11	36	32.5 02.5	....	36.0	8.4	35.8	....	
Do		25, a. m.	4	09	3	21	26.7 56.8	1	29	33.7 04.0	....	42.5	10.4	43.5	....	
Do		26, a. m.	3	06	2	14	32.5 02.7	0	22	13.2 43.0	....	44.0	8.6	35.2	.... ..	
Do		27, a. m.	3	14	2	18	26.5 56.5	0	25	37.7 07.8	....	41.0	8.8	38.0	....	
Do		28, a. m.	3	21	2	21	20.9 50.1	0	28	01.3 30.8	....	42.0	9.2	39.6	....	
Do		29, a. m.	3	29	2	25	14.0 43.8	0	31	27.7 58.0	....	46.0	8.9	35.9	....	

Do....................		30, a. m.	3 35	2 27	09.8 39.5	0 32	53.5 23.3	....	47.3	7.3	37.5	....
Do....................		31, a. m.	2 51	1 30	12.9 41.8	11 44	28.5 58.7	....	48.0	9.0	36.1	....
Do....................	June	1, a. m.	4 09	2 52	54.6 24.3	0 57	42.3 12.5	....	48.0	8.8	37.5	....
Do....................		2, a. m.	4 09	2 48	49.5 19.3	0 53	08 8 38.6	....	47.9	9.2	37 8	....
Do....................		3, a. m.	4 28	3 03	40.4 10.8	1 07	30.2 00.4	....	47.8	9.8	39.4	....
Do....................		4, a. m	4 43	3 14	32.0 02.3	1 17	52.2 22.2	....	49.3	10.0	39.7	....
Do....................		5, a. m.	5 23	3 50	19.5 49 7	1 53	11.6 41.3	....	48.4	10.2	38.3	....
Do....................		6, a. m.	5 59	4 22	08.3 37.8	2 24	29 4 59.5	....	53 6	9.7	40.2	....
Do....................		7, a. m.	5 56	4 15	03.8 33.5	2 16	56.5 26 3	....	47.2	9.0	37.7	....
Do....................		8, a. m.	5 54	4 08	58.3 28.1	2 10	24 7 25.0	....	48 7	9.9	35.9	....
Do....................		9, a. m.	6 38	4 48	45.0 14.7	2 49	44.2 14.4	....	51.3	10.3	37.6	....
Do....................		10, a. m.	6 05	4 11	44.8 14.7	2 12	19.2 49.2	....	53.5	9.6	34.6	....
Do....................		11, a. m.	9 02	7 04	10.2 40 0	5 04	14.3 44 0	....	56.0	9.8	40.1	....
Do....................		12, a. m.	6 54	4 52	27.4 57.5	2 52	08.6 38.4	....	46.0	7.7	30.8	....
Do....................		13, a. m.	8 27	6 21	07.5 37.3	4 20	16.8 46.5	....	42.0	9.0	40.7	....
Do....................		14, a. m.	9 12	7 01	55.2 24.8	5 00	29.0 59.3	....	52.0	11.2	44.3	....
Do....................		15, a. m.	5 41	3 27	26.4 56.7	1 25	37.5 07.7	....	51.3	7.1	30.3	....
Do....................		16, a. m.	6 19	4 01	14.7 44.5	1 58	54.0 23.8	....	46.8	9.9	31.6	....
Do....................		17, a. m.	6 29	4 06	09.0 38.5	2 03	20.3 50.4	....	48.0	8.3	36.0	....
Do....................		18, a. m.	5 40	3 14	12.3 42.2	1 10	58 0 27.6	....	49.0	8.4	34.5	....
Do....................		19, a. m.	5 43	3 13	08.7 38.4	1 09	23.7 53.8	....	49.0	7.3	37.6	....
Do....................		20, a. m.	5 42	3 08	04.2 33.8	1 03	48.7 18.7	....	50.2	8.9	39.4	....
Do....................		21, a. m.	6 29	3 50	53.2 22.8	1 46	06.5 36.2	....	39.3	7.5	38.8	....
Do....................		22, a. m.	5 53	3 10	56.0 25.5	1 05	39.0 09.0	....	47.0	7.2	37.4	....
Do....................		23, a. m.	5 56	3 09	51.2 20.8	1 04	07.7 37.5	....	....	9.4	35.0	.....
Do....................		24, a. m.	8 58	6 07	16.0 46.0	4 01	01.2 30.8	....	47.0	—9.3	—40.9	....

Comparison of the chronometers—Continued.

Place.	Date.	Comparator, sid. chron. 525.		Solar chronometer.									Temperature.	Daily relative rates.			Remarks.
				No. 8544.			No. 158.			No. 7961.				No. 8544.	No. 158.	No. 7961.	
	1860.	*h.*	*m.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	°	*s.*	*s.*	*s.*	
12th Camp, Fort Benton	June 25, a. m.	8	46	5	51	14.2 44.0	3	44	29.8 00.2	.....	.....	.....	53.0	—8.0	—37.1	....	
Do	26, a. m.	8	56	5	57	08.2 37.5	3	49	55.3 24.8	.....	.....	.....	62.0	8.5	37.2	....	
Do	27, a. m.	9	05	6	02	03.6 33.3	3	54	23.5 53.6	.....	.....	.....	53.3	6.9	34.0	....	
Do	28, a. m.	8	32	5	25	05.2 34.8	3	16	59.3 28.8	.....	.....	.....	47.5	8.0	34.0	....	
Do	29, a. m.	4	06	0	55	45.8 15.7	10	47	18.0 47.7	.....	.....	.....	44.7	6.9	28.9	....	
Do	30, a. m.	5	13	1	58	30.3 00.8	11	49	33.7 04.2	.....	.....	.....	50.0	9.0	37.2	....	
Do	July 1, a. m.	5	19	2	00	26.5 56.7	11	51	02.2 31.8	.....	.....	.....	48.7	6.5	35.0	....	
Do	2, a. m.	6	09	2	46	14.3 44.2	0	36	23.8 53.8	.....	.....	.....	54.7	8.3	34.2	....	
Do	3, a. m.	5	13	1	46	19.7 50.0	11	36	04.8 34.3	.....	.....	.....	56.3	7.7	39.5	....	
Do	4, a. m.	3	36	0	05	31.8 02.0	9	54	53.7 23.5	.....	.....	.....	46.3	8.0	31.0	....	
On board the Key West	5, a. m.	4	24	0	49	20.3 50.5	10	38	13.3 43.0	.....	.....	.....	54.0	7.8	36.7	....	
Cow Island	6, a. m.	4	00	0	21	20.4 50.6	10	09	48.8 18.5	.....	.....	.....	61.0	7.9	32.6	....	
Round the butte, Big Bend	7, a. m.	4	11	0	28	14.0 43.7	10	16	15.3 45.2	.....	.....	.....	....	8.9	35.5	....	
Buffalo Camp	8, a. m.	4	34	0	47	04.2 33.8	10	34	36.5 06.2	.....	.....	.....	58.5	10.2	39.3	....	
Mitchell's Creek	9, a. m.	4	44	0	52	58.2 27.8	10	40	02.2 32.0	.....	.....	.....	55.5	8.4	36.7	....	
Fort Union	10, a. m.	4	44	0	48	52.2 22.2	10	35	28.7 58.7	.....	.....	.....	55.5	9.9	37.5	....	
Do	11, a. m.	5	08	1	08	43.2 13.3	10	54	49.5 19.5	.....	.....	.....	56.0	9.1	39.4	....	
Do	12, a. m.	5	32	1	28	35.3 05.5	11	14	13.9 42.8	.....	.....	.....	60.3	8.1	36.7	....	
Big Bend Head	13, a. m.	6	08	2	00	24.7 55.0	11	45	35.2 05.5	.....	.....	.....	65.5	8.7	36.8	....	
Fort Clarke	14, a. m.	5	02	0	50	30.8 01.9	10	35	16.5 46.3	.....	.....	.....	60.0	9.8	22.9	....	

Biber Creek Mouth..........	15, a. m.	5	38	1	20	20.3 50.5	11	04	36.8 07.3	....	61.0	8.1	38.7	....
Little Shyenne River	16, a. m.	6	13	1	53	09.3 39.2	11	36	58.0 27.7	....	62.3	9.1	37.2	....
Fort Pierre	17, a. m.	5	54	1	30	08.2 37.8	11	13	29.7 00.0	....	65.0	8.5	35.9	....
Fort Lookout................	18, a. m.	6	15	1	47	01.2 30.7	11	29	55.2 25.0	....	72.3	7.7	35.5	....
Fort Randall................	19, a. m.	6	13	1	40	57.3 27.2	11	23	23.5 53.5	....	76.0	7.5	35.4	....
James River	20, a. m.	6	05	1	28	54.8 24.5	11	10	51.2 21.2	....	68.0	8.0	37.7	....
Sergeant's Bluff.	21, a. m.	7	03	2	22	41.5 11.7	0	04	07.7 37.4	....	67.5	7.8	38.3	....
Omaha City..................	22, a. m.	6	35	1	50	41.7 12.0	11	31	33.7 04.0	....	63.7	8.4	42.4	....
St. Joseph..................	23, a. m.	6	21	1	32	40.4 10.5	11	12	58.6 28.3	....	66.3	7.8	41.8	....
Lexington..................	24, a. m.	7	07	2	14	28.5 58.3	11	54	12.2 41.7	....	65.0	8.6	43.0	....
Jefferson City	25, a. m.	7	32	2	35	21.4 51.3	0	14	36.8 06.7	....	72.0	7.0	35.2	....
St. Louis....................	26, a. m.	6	37	1	36	27.5 57.7	11	15	14.4 44.2	....	75.3	6.9	35.6	....
Cincinnati..................	27, a. m.	6	55	1	50	22.2 52.3	11	28	34.8 05.0	....	70.3	6.4	40.5	....
Cumberland	28, a. m.	....	....	....	....	....	....	....	....	....	58.0	....	....	....
Washington, E. C., D. C....	29, a. m.	5	50	9	37	28.3 58.5	10	14	27.8 58.3	....	68.0	6.4	42.0	....
Do........................	30, a. m.	4	33	11	16	38.8 09.0	8	53	04.7 34.2	....	71.0	6.0	40.1	....
Do........................	31, a. m.	4	30	11	09	36.2 06.5	8	45	26.5 56.5	....	66.0	−7.1	−42.6	....

(E. C.) East corner, District of Columbia.

VOLUME B.

SEXTANT OBSERVATIONS.

Corrections to the reading of the vernier of sextant No. 1, (*Gambey.*)

Limb between.	No. of divisions, (16.)		Corrections for each minute of the vernier.
	Limb.	Vernier.	
° °			″
0 — 40	57	58	Add 2.
40 — 50	58	59	Add 1.
50 — 60	57	58	Add 2.
60 — 70	57	58	Add 2.
70 — 80	57	58	Add 2.
80 — 90	57	58	Add 2.
90 — 100	57	58	Add 2.
100 — 110	57	58	Add 2.
110 — 120	57	58	Add 2.
120 — 130	58	59	Add 1.
130 — 140	58	59	Add 1.
140 — 150	58	59	Add 1.

No correction needed for the readings of the vernier of sextant No. 2.

Sextant observations.

DALLES CITY.

Sextant, (Troughton & Simms, No. 2830,) called No. 2. Solar chronometer, (Frodsham, 7961.)

No.	Date.	Chron. 7961.			Double altitude. ☉			Remarks.
	1859.	h.	m.	s.	°	′	″	
1	May 11	8	27	12.4	122	46	35	
2	....do. ..		31	41.2		20	20	For latitude.
3	....do. ..		33	16.8		10	25	
4	....do. .		34	31.3		02	30	
5	May 11	0	18	07.5	59	40		For time.
6	....do. ..		18	35.7		30		
7	... do. ..		19	05.2		20		Observation for sun's diameter and index error of sextant.
8	....	0	24	24.2	57	29	30	
9	May 11		27	40.2	56	20		′ ″
10	....do. ..		28	10.3	56	10		Before: Diameter off the limb 32 30
11	....do. ..		28	39.4	56	00		on 31 20
12	...do. ..		29	06.0	55	50		
13	....do. ..		29	34.2	55	40		diameter .... 31 55 index error .... + 35
14	May 11		32	27.5	54	40		
15	....do. ..		32	55.0	54	30		After the observations: off.................... 32 15
16	... do. ..		33	23.6	54	20		on 31 00
17	....do. ..		33	52.5	54	10		
18	....do. ..		34	22.0	54	00		diameter 31 38
19	....do. ..		34	51.0	53	50		index error........... ..... + 37
20	....do. ..		35	20.5	53	40		
21	....do. ..		35	47.8	53	30		
22	....do. ..		36	17.0	53	20		
23	....do. ..		36	44.5	53	10		

Sextant observations—Continued.

COLUMBIA RIVER, BALDWIN'S ISLAND.

No. of reference.	Date.	Observed time, chron. 7961.			Double altitude sun's lower limb, sextant Gamb., No. 1.			Remarks.
	1859.	h.	m.	s.	°	′	″	
1	May 14	6	08	40.0	110	10		Off 32′ 20″ | 32′ 00″.
2	....do. ..		09	19.5		20		On 31′ 25″ | 31′ 30″.
3	....do. ..		09	56 8		30		
4	....do. ..		10	35.5		40		Temperature of the water in Columbia, 50°.
5	....do. ..		11	17.5		50		air in shade, 75°.5.
6	....do. ..		11	56.0	111	00		air, sheltered, 80°.
7	....do. ..		12	36.0		10		dry bulb, 75°. wet bulb, 60°.
8	May 14	6	18	03.0	112	30		surface of sand, 108°.
9	....do. ..		18	44.5		40		
10	....do. ..		19	28.5		50		Wind: N.NE., 4 force.
11	....do. ..		20	09.0	113	00		
12	....do. ..		20	50.2		10		Observations No. 1 to 17 for time.
13	....do. ..		21	33.5		20		No. 18 to 25 for latitude.
14	....do. ..		22	15.8		30		For the last set the degrees are marked doubtful. ....
15	....do. ..		22	58.0		40		
16	....do. .		23	42 2		50		
17	....do. ..		24	25.0	114	00		
18	May 14	7	57	28.5	121	08	40	Off 32′ 00″.
19	....do. ..		59	23.5		04	30	On 31′ 30″.
20	....do. ..	8	01	17.8		01	50	
21	....do. ..		02	42.5	120	59	15	Temperature: Shade, 82°.
22	....do. ..		04	17.7		56	10	Naked bulb, 83°.
23	....do. ..		06	29.0		51	05	Sand, 121°.
24	....do. ..		08	00.5		43	50	
25	....do. ..		10	50.0		38	15	

OLD FORT WALLA-WALLA. (NOW WALLULA.)

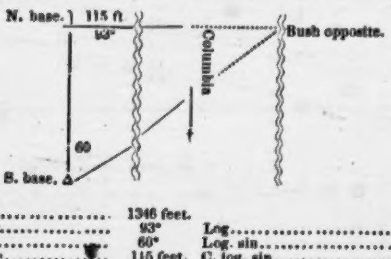
No.	Date.	Observed time, chron. 7961.			Double alti'de, sext. No. 1.			Remarks.
	1859.	h.	m.	s.	°	′	″	
1	May 15, p. m.	7	33	20.5	89	44	00	Observation at the centre of the fort.
2	......do.		36	43.0		43	50	Polaris the observed star for latitude.
3	......do.		39	08.0		44	00	Altitude of No. 1 marked doubtful.
4	......do.		43	26.5		44	35	
5	......do.		47	11.0		45	35	
6	May 15, p. m.	7	54	42.0	114	13	00	Observation on Vega for time.
7	......do.		56	58.0	115	00	35	
8	......do.		58	30.5	115	32	40	
9	......do.		59	46 0	116	01	00	
10	May 16, a. m	3	22	36.0	59	10		Observation on sun's lower limb for time.
11	......do.		23	05.8		20		
12	May 16, a. m.	3	24	30.8	59	50		
13	......do.		24	59 7	60	00		12h. 12m. 11s.7 p. m. Equal altitude.
14	......do.		25	31.7		10		
15	......do.	3	26	55.3	60	40		
16	......do.		27	24.8?		50		Temperature: Shade, 56°.
17	......do.		27	53.5	61	00		Water, 54°.
18	......do.		28	23.5		10		Wind: S. 4° W.; force, 5°.
19	......do.		28	52.0		20		
20	......do.		29	20.3		30		
21	......do.		29	50.3		40		
22	......do.		30	18.7		50		
23	......do.		30	48.0	62	00		
24	......do. ...		31	16.3		10		
25	......do.		31	45.0		20		
26	......do.		32	14.8		30		
27	......do.		32	42.8		40		
28	......do.		33	11.3		50		
29	......do.		33	41.0	63	00		

Sextant observations—Continued.

OLD FORT WALLA-WALLA. (WALLULA.)

No.	Date.	Observed time, chron. 7961.			Double alti'de, sext. No. 1.			Remarks.
	1859.	h.	m.	s.	°	′	″	
30	May 16, p. m.	12	12	11.7	60	00		
31	May 16, noon	7	31	35.0	125	09	10	Obervations made 50 feet in the direction S. 10° E. from
32	......do.		32	59.5		13	40	centre of fort, on sun's lower limb, for latitude.
33	......do.		34	17.0		16	45	
34	......do.		35	53.5		21	25	
35	......do		40	31.0		30	20	Temperature: Shade, 77°.5.
36	......do.		41	41.0		31	35	At noon: Sun, 79°.5.
37	......do.		42	35.0		32	55	Water, 60°.5.
38	......do.		43	46.0		34	10	
39	......do.		45	42.7		35	05	At 3h. p. m.: Shade, 81°.
40	......do.		47	11.7		35	40	7h. p. m.: Shade, 76°.
41	......do.		48	50.5		36	00	Wind: S.W. 5; cloudy.
42	......do.		50	36.2		35	50	
43	......do.		51	37.0		35	00	
44	......do.		53	04.8		33	50	
45	......do. ...	8	01	42.8		19	30	
46	......do.		02	40.0		17	05	Off 32′ 25″.
47	......do.		03	36.2		14	40	On 31′ 15″.
48	......do.		04	17.5		12	50	
49	......do. .. .		05	29.0		09	00	
50	May 17, a. m.	4	47	39.0	88	20		Observations for time on $\underline{\odot}$.
51	......do.		48	12.0		30		
52	......do.		48	42.5		40		Weather fine, nearly calm.
53	......do.		49	13.0?		50		Temperature: Ground in shade, 65°.3.
54	......do.		49	43.0	89	00		At 9h. a. m. on the Columbia.
55	..... do.	4	52	49.8	90	00		Air in shade or dry bulb, 65°.0.
56	......do.		53	19.0		10		wet bulb, 56°.5.
57	......do.		53	49.5		20		water, 60°.5.
58	......do.		54	21.5		30		Estimation:
59	......do. ...		54	51.0		40		Columbia at present 12 feet above low water.
60	......do. ...		55	23.0		50		Difference between high and low water, 18—20 feet.
61	......do.		55	53.5	91	00		
62	..... do.		56	26.0		10		
63	......do.	5	00	36.8	92	30		Temperature: Air in shade, 68°.5.
64	May 17, noon.	7	41	30.5	125	58	40	Observations for latitude on $\underline{\odot}$.
65	......do.		42	39.0	126	00	10	
66	......do.		44	45.2		03	20	Recorded 3′, should read 2′.?
67	.....do. ...		46	29.0		03	20	
68	......do.		48	31.8		03	20	
69	......do.		50	24.0		03	15	Off 32′ 10″.
70	......do.		52	25.6		02	00	On 31′ 20″.
71	......do.		54	07.0		00	10	Good. Temperature on ground, shade, 71°.
72	......do.		55	41.0	125	58	05	5 feet above, 77°.

NOTE.—In connexion with the hydrographic data obtained from Captain White, then of the steamer Colonel Wright, the following measurement of the width of the Columbia will be useful:



Base	1346 feet.
Angle at north base	93°
Angle at south base	60°
North base from shore line	115 feet.
Result: Width of Columbia	2443 feet.

Log.................................... 1346 = 3.1
Log. sin.................................... 60° = 9.9
C. log. sin.................................... 27 = 0.3

2561 3.4
— 115
— 3

2443

Sextant observations—Continued.

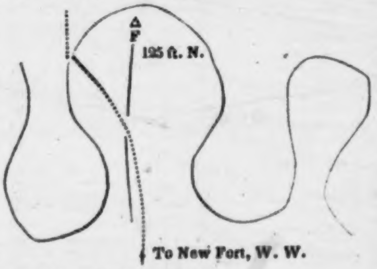
OLD FORT WALLA-WALLA. (WALLULA.)

In the same manner, the width of the Walla-Walla river was found to be 347 feet.

Temperature observations made on road from Walla-Walla to 1st camp:

h. m.
May 17, p. m., 1 15, at the first Indian camp, thermometer in the sun, 80°.
2 30, water of the Walla-Walla, 60°; wet bulb, 59°.5.
4 00, in the camp wagon, 81°.5.
4 40, water of the Walla-Walla, 60°.
7 15, temperature of the surface of ground, 66°.5; 8 inches above, 61°.5.
9 15, temperature of the air, 56°.
10 07, fine fire meteor.
11 00, northern light.

CROSSING OF TOUCHET.

No.	Date.	Observed time, chron. 7961.			Double alt'de of ☉, sext. No. 1.			Remarks.
	1859.	h.	m.	s.	°	′	″	
1	May 18 ..	6	06	01.0	112	10		Observation ☉,—off 32′ 20″. on 31′ 00″. No. 1 to 14 and 31 to 35 for time. No. 15 to 30 for latitude. NOTE.—The Touchet is here a beautiful winding river, 75 feet wide, average depth 4 feet, current 5 feet.  The lumber for bridge was ready. Observation for temperature. May 18, 5h. 00m. a.m., dry bulb 56°, wet 52°, water 58°, SW.3. 9 00....do....do....66.. do.57.5..do..56.3 Noon..........do....75.5 do.57 2 00 p.m....do....76.0 6 00....do....do....71.5 do.58.0..do..59.0, W.NW.2. 9 30....do..temp. of ground shaded by bushes and grass, 59°. May 19, 5 30 a. m., shade 44°, dew. 6 00....do..water 54 9 00....do....do..53.8 W. W. river, wet 52.4, dry 60°.5. 12 00 noon ....do..51.0 in a creek. Air 81.0, dry in shade. 1 15 p.m., water 60.5 of a warm creek. 1 30....do....do..54.5 of a mill-creek. 6 00....do..air....67.0 Walla-Walla. May 20, 7 00 a. m..do....56.0 in shade. Much snow on the Blue Mountains, 25 miles off.
2	....do....		06	43.0		20		
3	....do....		07	23.0		30		
4	....do....		08	02.8		40		
5	....do....		08	42.5		50		
6	....do....		09	24.0	113	00		
7	....do....		10	04.0		10		
8	....do....		10	44.5		20		
9	....do....		11	26.5		30		
10	May 18..	6	17	00.8	114	50		
11	....do....		17	43.0	115	00		
12	....do....		18	27.5		10		
13	....do....		19	10.0		20		
14	....do....		19	52.3		30		
15	May 18..	7	38	47.0	126	23	50	
16	....do....		40	19.5		27	10	
17	....do....		41	21.9		28	15	
18	....do....		42	29.8		29	30	
19	....do....		43	32.3		30	20	
20	....do....		44	45.8		30	45	
21	....do....		45	59.7		31	10	
22	....do....		47	25.5		31	15	
23	....do....		48	36.8		31	15	
24	....do....		49	43.0		30	45	
25	....do...		51	21.0		30	00	
26	....do....		52	51.9		28	35	
27	....do....		54	01.0		26	45	
28	....do....		56	00.8		25	15	
29	....do....		57	42.3		20	20	
30	....do....		59	06.4		17	30	
31	May 18..	9	33	05.5	111	00		
32	....do....		33	44.8	110	50		
33	....do....		34	21.5		40		
34	....do....		35	00.0		30		
35	...do....		35	38.0		20		

Sextant observations—Continued.

NEW FORT WALLA-WALLA. ☉

Equal altitude, chronometer 7961.

No.	Date.	Equal double alt., sex. No. 1.		Obser'd time, (7961,) a. m.			Obser'd time, (7961,) p. m.			Mean.			Remarks.
	1859.	°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
1	May 20	94	50	5	02	19.8	10	29	23.3	7	45	51.0	Off 32° 30′.
2	....do......	95	00		02	51.0		28	51.5			51.2	On 31° 00′.
3	....do......		10		03	23.5		28	20.3			51.9	9h. a m.; 66° in shade.
4	....do......		20		03	55.5		27	46.3			50.9	2h. 30m. p. m ; 108° ground.
			30		04	26.0		26	(*)	....	......	......	2h. 45m. p. m.; 110°.5 ground.
5	....do......		40		04	57.4		26	45.0			51.2	
6	...do......		50		05	30.0		26	13.5			51.7	
7	....do......	96	00		06	00.8		25	40.0			50.4	
8	....do......	97	00		09	11.8		22	29.8			50 8	
9	....do......		10		09	44.0		21	56.6			50.3	
10	...do......		20		10	16.5		21	24.3			50.4	
11	....do......		30		10	49.0		20	53.0			51.0	
12	....do.....		40		11	21.5		20	20.5			51.0	
13	....do......		50		11	54.3		19	48.5			51.4	
14	....do......	98	00		12	26.3		19	16.0			51.2	
			10		12	58.3			(†)	....	......	......	
			20		13	30.8	....	......	......	....	......	......	
15	...do......	99	50		18	23.8		13	19.5			51.6	
16	....do......	100	00		18	55.5		12	45.3			50.4	
17	....do......	100	30		20	35.8		11	06.8			51.3	
18	....do......		40		21	07.5		10	35.2			51.4	
19	....do......		50		21	40.8		10	01.6			51.2	
20	....do......	101	00		22	12.8		09	28.0			50.4	
21	May 21	78	30	4	11	45.3	11	19	42.5	7	45	43.9	Weather fine: wind, E., 1°.
22	....do......		40		12	15.5		19	13.5			44.5	
23	... do......		50		12	44.0		18	44.3			44.1	
24	....do......	79	00		13	14.7		18	14.5			44.6	
25	....do......		10		13	43.5		17	45.0			44.3	
26	....do......	82	00		22	07.0		09	20.0			43.5	
27	....do......		10		22	35.5		08	51.0			43.3	
28	....do......		20		23	07.5		08	21.0			44.2	
29	....do......		30		23	36.8		07	53.0			44.9	
30	May 22	75	00	4	00	34.8	11	30	44.3	7	45	39.5	Wind: a. m., W. 2; p. m., W. 3; p. m., therm. 86° in the sun.
31	....do......		10		01	04.0		30	15.5			39.7	
32	....do		20		01	32.5		29	45.8			39.2	
33	....do......		30		02	02.0		29	16.3			39.2	
34	....do.....		40		02	32.0		28	47.5			39.8	
35	....do......		50		03	00.5		28	17.8			39.2	The snow in the mountain melts considerable.
36	....do......	76	00		03	29.7		27	47 5			38.6	
37	....do......	77	00		06	27.0		24	52.3			39.7	
38	....do		10		06	55 0		24	22.0			38.5	
39	....do......		20		07	24.8		23	52.3			38.6	
40	....do......		30		07	54.2		23	23 8			39.0	
41	....do......		40		08	23.8		22	54.5			39.2	Off 32 10′.
42	....do......		50		08	52.5		22	26.0			39.3	On 31 20′.
43	....do	78	00		09	22.0		21	56.0			39.0	
44	....do......	79	00		12	19.0		18	58.5			38.8	
45	....do......		10		12	48 2		18	30.5			39.3	
46	....do......		20		13	17 2		17	59.5			38.4	
47	....do......		30		13	47.5		17	31.0			39.2	
48	....do......		40		14	16.7		17	00.5			38.6	
49	....do......		50		14	46.0		16	31.0			38.5	
50	....do......	80	00		15	16.0		16	00.5			38.3	
51	May 23	74	10	3	57	16.5	11	33	54.0	7	45	35.2	Good.
52	....do......		20		57	45.8		33	22.0?			33.9	Wind: a. m., W. 4; p. m., SW. 6.
53	....do......		50		59	12.7		31	52.0?			32.4	
54	....do......	75	00		59	42.0		31	23.3?			32.6	Observing difficult.
55	May 24	79	00	4	10	38.7	11	20	28.0	7	45	33.3	Wind: SW. 3°.
56	....do		10		11	08.0		19	56.0			32.0	Passing wagons loaded heavy with wood break the series of observation.
57	....do......	105	00	5	31	11.8	10	59	50.8			31.3	
58	....do......		10		31	45.5		59	18.0			31.8	
59	....do......		20		32	18.5		58	44.5			31.5	
60	....do......		30		32	51.8		58	08.5			30.2	
61	....do......		40		33	26.0		57	37.0			31.5	
62	May 25	63	40	3	25	22.8	12	05	46.2	7	45	34 5	Clear: W. 1°.
63	....do......		50		25	49.7		05	17.0			33.4	
64	....do......	64	00		26	19.0		04	48.7			33.8	

* Lost.

† Wagon passing by.

Sextant observations—Continued.

NEW FORT WALLA-WALLA. ☉

No.	Date.	Equal double alt., sex. No. 1		Obser'd time, (7961,) a. m.			Obser'd time, (7961,) p. m.			Mean.			Remarks.
	1859.	°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
65	May 25	64	10	3	26	48.5	12	04	20.5	7	45	34.5	
66	...do......		20		27	16.2		03	51.6			34.0	
67	....do......	65	00		29	13.0		01	54.5			33.7	
68	....do......		10		29	41.8		01	26.0			33.9	
69	....do......		20		30	09.7		00	57.5			33.6	
70	....do......		30		30	38.0		00	29.5			33.7	
71	....do......		40		31	06.5		00	00.5			33.5	
72	....do......		50		31	35.7	11	59	31.8			33.8	
73	....do......	66	00		32	04.5		59	01.8			33.2	
		67	00		lost.		....	....	....	......		......	
74	....do......		10		35	27.5		55	40.3			33.9	
75	....do......		20		35	56 2		55	12.2			34.2	
76	....do......		30		36	25.0		54	42.8			33.9	
77	....do......		40		36	54.8		54	14.3			34.5	
78	....do......		50		37	23.0		53	44.2			33.6	
79	....do......	68	00		37	51.8		53	15.0			33 4	
80	....do......	70	00		43	39.8		47	28.5			34.2	
81	....do......		10		44	08.7		46	59.0?			33.9	
82	....do......		20		44	37.2		46	28.5			32.9	
83	....do......		30		45	06.0		45	59.0			32.5	
84	....do......		40		45	34.8		45	32.0			33.4	
85	....do......		50		46	04.0		45	02.8			33.4	
86	....do.....	71	00		46	32.8		44	33.0			32.9	
87	... do......	74	00		55	17.3		35	51.0			34.1	
88	....do......		10		55	46.8		35	22.0			34.4	
89	....do......		20		56	15.5		34	51.8			33.7	
90	....do......		30		56	42.8		34	23.5			33.2	
91	....do......		40		57	12.8		33	52.0			32.4	
92	....do......		50		57	42.0		33	25.0			33.5	
93	....do......	75	00		58	11.2		32	55.0			33.1	
94	May 26	67	00	3	34	19.0	11	56	52.2	7	45	35.6	
95	....do......		10		34	47.7		56	23.0			35.4	
96	....do......		20		35	17.3		55	54.3			35.8	
97	....do		30		35	45.2		55	25.0			35.1	
98	....do......		40		36	14.8		54	55.0			34.9	
99	... do		50		36	34.6		54	27.0			35.8	
100	....do......	68	00		37	11.8		53	58.0			34.9	
101	....do......		10		37	41.2		53	27.8			34.5	
102	....do......		20		38	10.5		53	00.2			35.4	
103	....do......		30		38	38 8		52	31.0			34.9	
104	....do......		40		39	08.5		52	01.3			34.9	
105	....do......		50		39	37.6		51	33.5			35.5	
106	....do......	69	00		40	06.2		51	05.7			35.9	
107	....do......		30		41	34.0		49	37.8			35.9	
108	....do......		40		42	03.4		49	08.6			36.0	
109	....do......	73	00	3	51	43.2	11	39	28.5			35 8	
110	....do		10		52	12.2		38	58.6			35.4	
111	....do......		20		52	41.8		38	30.5			36.1	
112	....do		30		53	10.5		38	01.4			36.0	
113	....do......		40		53	39.2		37	32.0			35.6	
114	....do......		50		54	09.0		37	02.8			35.9	
115	...do......	74	00		54	37.0		36	34.0			35.5	
116	....do......		10		55	06.7		36	05.0			35.8	
117	....do......		20		55	35.2		35	35.3			35.3	
118	....do......		30		56	04.8		35	06.8			35 8	
				523 p. m.			525 a. m.						
119	May 26, 27	80	00	10	48	55.0	3	44	16.5	19	16	35.7	
120	....do......	79	50		49	25.7		43	47.3			36.5	
121	....do......		40		49	55.8		43	17.7			36.7	
122	....do......		30		50	24.8		42	48.5			36.6	
123	....do......		20		50	53.8		42	18.8			36.3	
124	....do......		10		51	23.2		41	49 5			36.4	
125	....do......	79	00		51	53.0		41	19.8			36.4	
126	....do	63	00	11	38	28.5	2	54	47.0			37.7	
127	....do......	62	50		38	58.0		54	19 0			36.5	
128	....do......		40		39	26.0		53	49.5			37.8	
129	....do......		30		39	56.5		53	20.5			38.5	
130	....do.....		20		40	25.2		52	52.0			38.6	
131	....do.....		10		40	53 5		52	23.0			38.3	
132	....do......	62	00		41	22.2		51	53.5			37 9	
133	....do......	60	00		47	10.8		46	06.2			38.5	
134	....do.....	59	50		47	39.2		45	35.7			37.6	
135	....do......		40		48	08.8		45	08.0			38.4	
136	....do......		30		48	37.8		44	38.2			38.0	
137	....do......		20		49	06.5		44	10.2			38 4	
138	....do......		10		49	34.5		43	41.8			38.2	
139	... do......	59	00		50	03.7		43	12.8			38.3	

Comparison of chron. 7961 with 525, after the observation by J. W. and Th. K.

525.			7961.			
h.	m.	s.	h.	m.	s.	
10	45	00	11	15	04.5	W.
	46	00		16	04.8	K.
	46	30		16	34.9	K.
	58	00		28	02.5	W.
	59	00		29	02.2	W.
11	00	00		30	02.0	W.
	01	00		31	01.8	W.
	12	00		42	00.2	K.
	12	30		42	30.4	K.
	13	00		43	00.0	K.
	13	30		43	30.2	K.
	15	00		44	59.8	K.
	15	30		45	29.6	K.

Afterwards, the time observations are made by the sid. 525, to obtain the error for midnight.

Sextant observations—Continued.

NEW FORT WALLA-WALLA. ☉

No.	Date.	Equal 2 alt., sext. No. 1.	Chron. 525, a. m.	Chron. 525, p. m.	Mean.	Remarks.
	1859.	° ′	h. m. s.	h. m. s.	h. m. s.	
140	May 27....	56 00	2 34 31.3	12 03 27.0	7 18 59.2	Off 32′ 20″.
141	....do......	10	34 59.8	02 56.6	58.2	On 31′ 10″.
142	....do......	20	35 28.8	02 28.5	58.7	
143	....do.....	30	35 58.7	01 59.0	58.9	
144	....do......	40	36 27.5	01 30 7	59.1	
145	....do......	57 00	37 24.8	00 33.0	58.9	
146	....do	58 00	40 18.5	11 57 39.0	58 8	
147	.. do......	10	40 48.0	57 10.0	59.0	
148	... do......	20	41 18.0	56 41 4	59.7	
149	....do......	30	41 46.5	56 12.8	59.6	
150	....do......	40	42 14.0	55 44.0	59.0	
151	....do......	50	42 43.5	55 14.8	59.2	
152	....do......	59 00	43 12.8	54 46.3	59.5	
153	....do......	61 00	49 00.5	48 59.2	59.8	
154	....do.....	20	49 57.5	48 00.0	58 8	
155	....do......	30	50 25.3	47 31.0	58.2	
156	....do......	40	50 54.8	47 03.0	58.9	
157	....do......	50	51 24.0	46 33 2	58.6	
158	....do.....	62 00	51 53.5	46 05.8	59 7	
159	June 1....	67 00	....	11 54 51.7	....	NOTE.—Mr. P. M. Engel observed the azimuth of the sun by compass at 4h. 12m. 21s. to be 263° 30′ for magnetic variation.
	....do......	10	....	54 21.8	....	
	....do......	20	....	53 53.3	....	
	....do......	30	....	53 23.6	....	
	....do......	40	....	52 55.8	....	
	....do......	50	....	52 26.4	....	
	....do......	68 00	....	51 57.5	....	
	....do......	10	....	51 29.8	....	
	....do......	78 00	3 55 41 8	....	....	From south and north mark 20° 00′. East.
	....do......	10	56 11.6	....	....	
	....do......	20	56 41.0	....	....	
	....do......	30	57 10.0	....	....	
	....do......	40	57 39.3	....	....	
	....do......	50	58 08.7	....	....	
	....do......	79 00	58 37.5	....	....	

LATITUDE.

No.	Date.	Object.	Chron. 7961.	Double alt., sext. No. 1.	Resulting meridian 2 alt.	Remarks.
	1859.		h. m. s.	° ′ ″		
1	May 20....	Sun's lower limb.	7 29 56.0	126 57 40	....	Wind E. 2.
2	....do		30 55.5	127 00 50	....	Shade 74.5.
3	....do......	....	37 30.0	12 20	....	Ground 105°.
4	....do	....	38 41.0	17 20	....	
5	....do	....	39 57.0	18 15	....	
6	....do.....	....	41 27.0	20 40	....	
7	....do......	....	43 48 7	21 50	....	
8	....do......	....	45 20 5	22 40	....	
9	.. do.....	....	47 13.8	22 00	....	
10	....do......	....	48 14.8	21 40	....	
11	....do......	....	50 05.5	20 35	....	
12	... do......	....	53 49.5	16 15	....	
13	....do.....	....	54 41.7	14 40	....	
14	....do......	....	56 05.2	12 00	....	
15	....do......	....	58 03.0	08 00	....	Ground 108°.
16	....do......	Polaris L. C..	4 23 39.0	89 15 40?	....	Faint.
17	....do......	....	33 36.0	15 15?	....	
18	....do......	....	40 37.5	14 50	....	
19	....do	....	43 23 0	14 00	....	
20	....do......	....	49 08.0	14 00	....	
21	....do......	....	51 46 0	14 00	....	
22	....do......	....	57 09.0	14 00	....	
23	May 21....	Sun's lower limb.	7 41 23.5	127 45 25	....	8 feet south of astr'l station.
24	....do......		43 07.2	46 55	....	
25	....do......	....	45 13.8	47 20	....	
26	....do......	....	46 43.0	47 20	....	
27	....do......	....	48 00.8	46 50	....	
28	....do......	....	50 13.0	45 10	....	
29	....do......	....	52 16.0	43 00	....	

Sextant observations—Continued.

NEW FORT WALLA-WALLA. O

No.	Date.	Object.	Chron. 7961.			Double alt., sext. No. 1.			Resulting meridian 2 alt.	Remarks.
			h.	m.	s.	°	′	″		
30	1859. May 22....	Sun's lower limb.	7	41	32.5	128	09	40	....	
31	....do......			43	18.0		10	40	....	
32	....do......	....		45	15.0		11	15	....	
33	....do......	....		47	47.0		10	35	....	
34	....do......	....		49	43.7		09	10	....	
35	May 23....	Sun's lower limb.	7	37	03.0	128	27	10	....	
36	....do......			38	35.8		30	00	....	
37	....do......	....		40	30.8		32	25	....	
38	....do......	....		41	55.3		33	35	....	
39	....do......	....		44	45.0		34	30	....	
40	....do......	....		45	48.0		34	30	....	
41	....do......	....		47	54.7		33	45	....	
42	....do......	....		49	23 0		33	10	....	
43	....do......	....		51	26.0		31	30	....	
44	....do......	....		52	42.5		29	20	....	
45	....do......	....		53	53.5		27	40	....	
46	May 24....	Sun's lower limb.	7	44	05.5	128	57	00	....	Off 32′ 20″.
47	....do......			45	57.0		57	08	....	On 31′ 05″.
48	....do......	....		47	57.5		56	37	....	
49	....do......	....		49	55.2		55	15	....	
50	....do......	....		51	19.0		53	40	....	
51	....do......	....		52	49.0		51	35	....	
52	May 25....	Sun's lower limb.	7	33	48.0	129	05	20	....	
53	....do......			34	56.5		07	50	....	Gambey: sext. No. 1.
54	....do......	....		43	28.5		18	35	....	
55	....do......	....		44	31.7		18	50	....	
56	....do......	....		45	47.0		19	10	....	
57	....do......	....		46	46.3		18	45	....	
58	....do......	....		53	11 5		13	15	....	
59	....do......	....		54	08 8		11	20	....	
60	....do......	....		57	53.5		04	00	....	
61	....do......	....	7	38	12.0	129	12	05	....	
62	....do......	....		39	19.5		13	30	....	Throughton and Simms's sext. No. 2.
63	....do......	....		47	50.8		16	50	....	
64	....do......	....		48	43.4		16	00	....	Off 32′ 20″.
65	....do......	....		55	35.5		07	10	....	On 31′ 00″.
66	....do......	....		56	27 0		05	15	....	
67	....do......	....	7	40	29.0	129	18	30	....	Sext., Blunt, No. 11.
68	....do......	....		42	18.5		19	50	....	No. 3, (called.)
69	....do......	....		49	56.0		18	00	....	Index error — 39″, 3 obs.
70	....do......	....		51	15.5		17	20	....	
71	May 26....	Sun's lower limb.	7	45	20.0	129	40	05	....	Sext. No. 1.
72	....do......			46	37.0		40	00	....	Off 32′ 20″.
73	....do......	....		47	48.5		39	45	....	On 31′ 10″.
74	....do......	....		54	28.0		31	50	....	
75	....do......	....		55	20.0		30	25	....	
76	....do......	....	8	10	51.7	128	36	50	....	
77	....do......	....		12	03.0		30	50	....	
78	....do......	....		12	45.0		26	30	....	
79	....do......	....	7	49	20 0	129	37	20	....	Sext. No. 2.
80	....do......	....		50	26.0		35	40	....	Off 32′ 25″.
81	....do......	....		56	25.5		27	00	....	On 31′ 00″.
82	....do......	....		57	19.3		25	00	....	
83	....do......	....	8	04	37.8		02	30	....	
84	....do......	....		07	14.2	128	52	20*	....	* Wagons passing.
85	....do......	....		08	03.8		48	40	....	
88	....do......	....	7	51	38.5	129	37	50	....	Sext No. 3.
89	....do......	....		53	20.5		35	40	....	Off 30′ 30″.
90	....do......	....		58	38.7		24	30	....	On 32′ 40″.
91	....do......	....		59	56.5		20	40	....	
92	....do......	....	8	01	23 8		16	45	....	
93	....do......	....		02	19.2		13	20	....	
94	....do......	....		03	07.5		10	20	....	

Sextant observations—Continued.

NEW FORT WALLA-WALLA. ☉.

No.	Date.	Object.	Chron. 7671.			Double alt.			Resulting meridian, 2 alt.	Remarks.
			h.	m.	s.	°	′	″		
	1859.									
95	May 27....	Sun's lower limb.	7	34	58.7	129	50	10	....	Sext. No. 3.
96	....do......			35	51.0		51	35	....	
97	....do......	....		43	38.0		60	30	....	
98	....do......	....		44	38.0		61	20	....	
99	....do......	....		58	40.5		41	20	....	
100	....do......	....		59	34.0		42	00	....	
101	....do......	....	8	00	55.5		37	40	....	
102	....do......	....	7	31	29.5	129	39	00	....	Sext. No. 2.
103	....do......	....		32	33.0		41	50	....	
104	....do......	....		41	41.5		57	50	....	
105	....do......	....		42	40.5		58	10	....	
106	....do......	....		53	05.0		53	30	....	
107	....do......	....		55	15.5		49	50	....	
108	....do......	....		57	32.5		44	45	....	
109	....do......	....	7	28	45.0	129	32	00	....	Sext. No. 1.
110	....do......	....		29	41.0		35	00	....	
111	....do......	....		39	11.0		56	20	....	
112	....do......	....		40	22.0		57	40	....	
113	....do......	....		45	50.8	130	01	05	....	
114	....do......	....		47	37.5		01	05	....	
115	....do......	....		48	52.0	129	59	50	....	
116	....do......	....		50	25.0		58	20	....	
117	....do......	....		51	51.0		56	40	....	
118	....do......	....	8	02	33.0		31	45	....	
119	....do......	....		03	27.8		28	30	....	
120	May 31....	Polaris	19	13	29.5	90	05	25	....	Chron. 525; sext. No. 1.
121	....do......	....		19	54.0		09	10*	....	* Corr'd for vernier.
122	....do......	....		16	41.5	90	06	10	....	Chron. 525; sext. No. 2.
123	....do......	....		24	35.0		09	40	....	
124	....do......	α Scorpii....	19	28	37.0	35	42	10	....	Chron. 525; sext. No. 1.
125	....do......	....		32	46.4		41	00	....	
126	June 1....	Sun's lower limb.	7	28	28.7	131	28	10	....	Chron. 525; sext. No. 2.
127	....do......			30	00.5		21	00	....	
128	....do......	....		31	50.2		24	20	....	Off 32′ 20″.
129	....do......	....		38	12.5		29	55	....	On 30′ 45.
130	....do......	....		40	10.5		29	50	....	
131	....do......	....		41	24.0		29	30	....	
132	....do......	....		47	13.5		23	20	....	
133	....do......	....		48	21.0		21	40	....	
134	....do......	....		49	09.4		19	55	....	
135	June 1...	Sun's lower limb.	7	22	39.5	131	03	10	....	Sext. No. 1.
136	....do......			24	14.5		08	30	....	
137	....do......	....		25	07.2		11	00	....	
138	....do......	....		33	52.0		28	20	....	
139	....do......	....		35	03.0		29	40*	....	*Corr'd for vernier.
140	....do......	....		36	19.8		30	30	....	
141	....do......	....		42	34.5		30	30	....	
142	....do......	....		44	19.5		28	55	....	Off 31′ 40″.
143	....do......	....		45	32.3		27	35	....	On 30′ 40″.
144	....do......	....		50	38.2		18	10	....	
145	....do......	....		51	13.3		16	25	....	
146	....do......	....		52	48.5		13	10	....	

Sextant observations—Continued.

OLD FORT WALLA-WALLA. (WALLULA.)

No.	Date.	Eq double alt. O		Chron. 7961, a. m.			Chron. 7961, p. m.			Mean.			Remarks.
	1859.	°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
62	June 3...	98	00	5	04	11.5	10	32	33.0	7	48	22.3	Sextant No. 2. McKneight, an excellent axeman, our best chronometer carrier, observing the time on this trip pretty accurate, made only three mistakes, of one minute, easy found—one by Th. Kolecki and two by myself.
63	....do....	98	30		05	44.7		30	59 0			21.8	
64	....do....	99	00		07	18.0		29	26.8			22.4	
65	... do....	99	30		08	50.5		27	52.0			21 3	
66	....do....	100	00		10	25.0		26	19.1			22.0	
67	....do....	100	30		11	59.0		24	44.5			21.8	
68	....do....	101	30		15	09.0		21	35.5			22.2	
69	....do....	102	30		16	44.0		20	00.0			22.0	
70	....do....	102	30		18	19.5		18	24.2			21.8	
71	....do....	103	00		19	55.0		16	49.0			22.0	
72	....do....	105	20		27	26.5		09	17.5			22.0	
73	....do.. .	105	40		28	31.5		08	10.5			21.0	
74	....do....	106	00		29	36.7		07	05.5			21.1	
75	....do....	106	20		30	42.8		06	00.0			21.4	
76	....do....	109	00		39	37.0	9	57	07.0			22.0	

No.	Date.	Object.	Chron. 7961.			Double alt., sext. No. 2.			Result'g meridian, double alt.	
	1859.		h.	m.	s.	°	′	″		
77	June 3...	Sun's lower limb.	7	37	38.0	131	48	10		Observations for latitude, No. 77 to 83, observed with two red glasses. Sun bright, or nearly so.
78	....do ...			40	26.0		53	50		
79	....do....			42	17.0		56	15		
80	....do....			43	59.0		58	00		
81	....do....			46	12.0		59	55		No. 84 green (light) glasses.
82	.. .do....			48	52.0		59	58		No. 85 to 87 with red glass. Sun clouded.
83	....do....			50	59.0		59	38		
84	....do....			53	32.0		57	10		
85	....do....		8	03	46.0		35	30		Off 32° 15′ } Used the red glasses.
86	....do....			05	26.0		30	05		On 30° 20′ } Used the red glasses.
87	....do....			07	08.0		23	20		Chronometers compared before and after the trip. (See vol. A.)

NEW FORT WALLA-WALLA. O

No.	Date.	Equal 2d alt. sext. No. 1.		Chron. 525, p. m.			Chron. 525, a. m.			Mean.			Remarks.
	1859.	°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
159	June 7, 8	61	00	12	39	32.2	3	32	08.3	20	05	50.2	
160	....do......	60	50		40	00.8		31	40.0			50.4	
161	....do......		40		40	30.7		31	10.8			50.7	
162	... do......		30		41	00.0		30	42.2			51.1	The intermediate observations rejected; disturbed by walking.
163	....do......	58	50		45	49.0		*25	52.0			*50.5	
164	....do......		40		46	18.0		25	22.8			50.4	
165	....do......		30		46	47.2		24	53.8			50.5	
166	....do......		20		47	16.8		24	25 0			50.9	The a. m. observations are made with index error + 22.5″.
167	....do......		10		47	46.0		23	56.6			51.3	
168	....do......		00		48	14.2		23	27.6			50.9	The p. m. observation +20′ 0″.
169	....do......	57	50		48	43.2		22	59 0			51.1	P. m. changed a. m.
170	....do......		00		51	07.8		20	32.7			50.3	Off 31′ 55″ to 32′ 10″.
171	....do......	56	50		51	36.8		20	05.2			51.0	On 31′ 15″ to 31′ 25″. 63′ 20″ to 63′ 35″.
172	....do......		40		52	05.7		19	37.4			51.5	
173	....do......		30		52	34.5		19	06.8			50.7	*Walking.
174	....do......		20		*53	04.6		18	37.8			51.2	
175	....do......		10		53	33.2		18	08.2			50.7	
176	....do......		00		54	02.3		17	40.4			51.3	
177	June 8	61	00	12	44	01.2	3	32	08.3	8	08	04.8	
178	....do......	60	50		44	30.8		31	40.0			05.4	
179	....do......		40		45	00.0		31	10.8			05.4	
180	....do......		30		45	29.0		30	42.2			05.6	
181	....do......	58	50		50	19.2		*25	52.0			05.6	
182	....do......		40		50	48.0		25	22.8			05.4	
183	....do......		30		51	17.3		24	53.8			05 5	
184	....do......		20		51	45.6		24	25.0			05.3	
185	....do......		10		52	13.8		23	56.6			05.2	
186	....do......		00		52	42.0		23	27 6			04.8	
187	....do......	57	50		53	13.0		22	59.0			06.0	

Sextant observations—Continued.

NEW FORT WALLA-WALLA. ☉

No.	Date.	Equal 2d alt. sext. No. 1.		Chron. 525, p. m.			Chron. 525, a. m.			Mean.			Remarks.
		°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
188	June 8	56	40		56	35.7		19	37.4			06.5	
189	....do......		30		57	03 8		19	06.8			05.3	
190	....do......		20		57	33.0		18	37.8			05.4	
191	... do......		10		58	01.2		18	08.2			04.7	
192	....do......		00		58	31.4		17	40.4			05.9	
193	June 8, 9	64	40	12	33	25.5	3	46	34.0	20	09	59.7	
194	....do......		30		33	54.8		46	05 8			60.3	
195	....do......		20		34	23.2		45	37.2			60.2	
196	... do......	62	40		39	12.0		40	48.0			60.0	
197	....do......		30		39	41.2		40	17.0			59.1	
198	....do......		20		40	10.3		39	49 8			60.0	
199	....do ...	57	50		53	13.0		55	43.0			58.9	Disturbed by cows.
200	June 10, 11	64	50	12	41	50.2	3	54	44 7	20	18	17.5	
201	....do......		40		42	19.9		54	15.0			17.5	
202	....do......		30		42	49.6		53	46.0			17.8	
203	....do......		20		43	16.9		53	17.3			17.1	
204	....do		10		43	46.0		52	49.4			17.7	
205	....do......	64	00		44	14.3		52	20.0			17.2	
206	....do......	62	50		47	37.0		48	57.6			17.3	
207	....do......		40		48	06.5		48	28.2			17.4	
208	....do......		30		48	35.0		47	59.4			17.2	
209	...do		20		49	04.4		47	30.2			17.3	
210	....do......	62	10		49	33.0		47	02.3			17.6	
211	....do......	61	00		52	55.5		43	39.3			17.4	
212	....do......	60	50		53	25.4		43	10.4			17.9	
213	... do......		40		53	54.3		42	42.0			18.1	
214	....do......		30		54	22.5		42	13.5			18.9	
215	....do......		20		54	52.0		41	45.2			18.6	
216	....do......	60	00		55	49.6		40	47.8			18.7	
217	June 11	64	48	12	46	45.2	3	54	15.0	8	20	30.1	
218	....do......		30		47	13.6		53	46.0			29.8	
219	....do......		20		47	42.7		53	17.3			30.0	
220	...do......		10		48	12.0		52	49.4			30.7	
221	....do......	64	00		48	41.0		52	20.0			30.5	
222	....do,......	63	00		51	34.2		49	25 8			30.0	
223	....do......	62	50		52	03.5		48	57.6			30.5	
224	....do......		40		52	32.3		48	28.2			30.3	
225	....do.....		30		53	01.0		47	59.4			30.2	
226	....do......	62	20		53	30.3		47	30.2			30.2	Off 31′ 10″ to 31′ 00″.
227	...do......	62	10		53	59.2		47	02.3			30.7	On 30′ 40′ to 30′ 50″.
228	...do......	61	00		57	21.0		43	39.3			30.2	
229	....do......	60	50		57	50.6		43	10.4			30.5	
230	....do.....	60	30		58	48.2		42	13.5			30.8	
231	....do......	60	20		59	17.3		41	45.2			31.2	After these observations, changed the index error.
232	....do......	60	00		60	15.2		40	47.8			31.5	
233	June 16	106	20	11	04	29.6	6	18	10.0	8	41	19.8	Off 31′ 20″.
234	....do......		30		03	57.5		18	40.8			19 2	On 31′ 40″.
235	....do......		40		03	25.7		19	14.0			19.8	
236	....do......		50		02	53.2		19	45.3			19.3	
237	....do......	107	00		02	20.8		20	17 3			19.1	
238	....do......		10		01	48.4		20	49 8			19.1	
239	....do......		20		01	16.0		21	23.2			19.6	
240	...do......		30		00	43.4		21	54 8			19.1	
241	...do......		40		00	11.3		22	28.2			19.7	
242	... do......	109	00	10	55	47.3		26	50.1			18.7	
243	June 16, 17	106	20	11	04	29.6	6	22	09.4	20	43	19.5	Off 31′ 40″.
244	....do......		30		03	57.5		22	40.6			19.0	On 31′ 40″.
245	....do......		40		03	25.7		23	14.0			19.8	
246	... do.....		50		02	53.2		23	45.6			19.4	
247	....do......	107	00		02	20.8		24	17.7			19.3	
248	....do		10		01	48.4		24	51.0			19.7	
249	....do......		20		01	16.0		25	23.1			19.5	
250	....do......		30		60	43 4		25	54.8			19.1	
251	....do......		40		00	11.3		26	27.8			19.5	

Sextant observations—Continued.

NEW FORT WALLA-WALLA. O

No.	Date.	Equal 2d alt. sext. No. 1.	Chron. 525, p. m.	Chron. 525, a. m.	Mean.	Remarks.
	1859.	° ′	h. m. s.	h. m. s.	h. m. s.	
252	June 17	105 00	11 13 04.3	6 17 52.8	8 45 28.5	
253	... do......	10	12 31.9	18 25.4	26.7	
254	....do.....	20	12 00.0	18 56.0	28.0	
255	...do......	30	11 28 5	19 28 3	28.4	
256	....do......	40	10 56.3	20 01.0	28.6	
257	...do	50	10 25.0	20 32.8	28.9	
258	....do......	106 00	09 52.4	21 04.1	28.3	
259	....do......	10	09 20.6	21 36.8	28.7	
260	....do......	20	08 48.4	22 09.4	28.9	
261	... do....	30	08 16.8	22 40.6	28.7	
262	....do......	40	07 45.3	23 14.0	29.6	
263	....do......	50	07 11.6	23 45.6	28 6	
264	....do......	107 00	06 40.0	24 17:7	28.9	
265	... do......	10	06 07.6	24 51.0	29.3	
266	....do......	20	05 35.3	25 23.1	29.2	
267	....do......	30	05 04.8?	25 54.8	29.8	
268	June 17, 18	105 00	11 13 04.3	6 21 58.0	20 47 31.2	
269	... do......	10	12 31.9	22 29.4	30.7	
270	....do.....	20	12 00.0	23 01.8	30.9	
271	....do......	30	11 28.5	23 32.8	30.6	
272	....do......	40	10 56 3	24 05.0	30.7	
273	....do......	50	10 25.0	24 36.4	30.7	
274	....do......	106 00	09 52.4	25 09.0	30.7	
275	....do......	20	08 48.4	26 13.7	31.0	
276	....do......	30	08 16.8	26 45.0	30.9	
277	....do......	40	07 45.3	27 17.5	31.4	
278	...do......	50	07 11 6	27 50.0	30.8	
279	....do.....	107 00	06 40.0	28 22.2	31.1	
280	....do......	10	06 07.6	28 54.2	30.9	
281	....do......	20	05 35 3	29 27.0	31.2	
282	....do......	30	05 04.8?	29 58.3	31.5	
283	June 22	89 10	*11 03 46.0	*4 32 28.3	7 48 07.2	*Chron. 7961.
284	....do......	20	03 17.5	32 57.3	07.4	Off 31′ 20″.
285	... do......	30	02 47.2	33 26.8	07.0	On 31′ 30″.
286	....do......	40	02 18.5	33 56.6	07.5	Temperature on the ground 140°
287	....do......	50	01 48.4	34 26.3	07.4	air, in shade, 105°.5.
288	....do......	90 00	01 18.7	34 55.8	07.3	Barometer, 29.176 104°.
289	....do.....	91 40	10 56 21.2	39 53.8	07.5	
290	....do.....	50	55 52.0?	40 23.0	07.5	

OBSERVATIONS OF TIME.

Date.	Equal double altitudes by sidereal chronometer, Eggert & Son, No. 525.							Mean.
	92° 30′	92° 40′	92° 50′	93° 00′	93° 10′	93° 20′	93° 30′	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
June 18, a. m....	5 43 30.2	44 00.3	44 31 0	45 00.8	45 31.0	46 00.0	46 30.7	......
App. noon......	8 49 39.7	39.3	40.2	40.4	40.1	39.8	40.0	39.9
June 18, p. m.	11 55 49.2	55 18.3	54 49 4	54 20.0	53 49 2	53 19.6	52 48.3	......
App. midnight.....	8 51 43.2	42.4	42.7	42 8	42.7	43.3	42.7	42.8
June 19, a. m..........	5 47 37.2	48 06.4	48 36.0	49 05.5	49 36 3	50 07.0	50 37.0	......
App. noon..............	8 53 50.2	50.2	50.3	50.6	50.3	50.7	50.9	50.5
June 19, p. m..........	11 60 03.3	59 34.0	59 04.6	58 35.7	58 04.2	57 34.5	57 04.8	......
App. midnight.........	8 55 53.8	54.2	54.5	55.1	54.8	54.7	51.9	54.6
June 20, a. m..........	5 51 44.3	52 14.4	52 44.3	53 14.6	53 45.5	54 15.0	54 45.0	......
App. noon.............	8 56 01.0	01.6	01.5	01.4	02.1	01.7	....	01.5
June 20, p. m.	12 04 17.8	03 48.8	03 18.7	02 48.3	02 18.8	01 48.3	....	......

Sextant observations.—Continued.

NEW FORT WALLA-WALLA. ☉

Date.	Equal double altitudes by sidereal chronometer, Eggert & Son, No. 525.							Mean.
	95° 00′	95° 10′	95° 20′	95° 30′	95° 40′	95° 50′	96° 00′	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
June 18, a. m. ..	5 51 03.2	51 31.8	52 02.2	52 33.0	53 03.2	53 33.0	54 03.0	
App. noon......	8 49 40.4	39.5	39.7	40.0	40.1	40 3	39.5	39.9
June 18, p. m. ..	11 48 17.6	47 47.2	46 17.2	46 47.0	45 17.0	45 47.7	16.0	
Appr. midnight..	8 51 42.2	42.7	42.8	42 9	42.8	43.0	42.4	42.7
June 19, a. m...	5 55 06.8	55 38.2	56 08.5	56 38.7	57 08.5	57 38.4	58 08.8	
App. noon......	8 53 49.7	50 9	50.9	51.7	....	....	....	50.8
June 19, p. m...	11 52 32 5	52 03.7	51 33.3	51 04 8	....	....	....	
App. midnight ..	....	55.1	54.8	55.6	....	....	....	55.2
June 20, a. m...	....	5 59 46.5	6 00 16.3	00 46 4	01 16.6	01 47.0	02 17.7	
App. noon......	....	01.6	01.4	01.6	01 5	01.1	01.8	01.5
June 20, p. m. ..	11 56 47.0	56 16.7	55 46.5	55 16.8	54 46.4	54 15.2	53 46.0	

LATITUDE.

No.	Date.	Object.	Sid. chron. 525.	Double altitude.	Resulting meridian, double altitude.	Remarks.
	1859.		h. m. s.	° ′ ″		
147	June 9.	Sun's lower	8 05 08.2	133 11 35	....	Sext. No. 1.
148	....do........	limb.	06 17.0	13 25	....	Off 31′ 32″. } Doubtful.
149	...do........	....	10 49 6	16 50	....	On 30′ 25″. }
150	....do	....	11 54.0	17 10	....	Index error has been changed
151	....do.......	....	15 16 5	15 50	....	on June 8th before a. m. observations.
152	....do.......	....	16 12.0	15 10	....	
153	....do.......	....	19 23.0	11 20	....	Use the mean of the following
154	....do.......	....	20 14.2	10 00	....	index err. for sext. No. 1.
155	....do.......	....	8 08 51.2	133 14 10	....	Sext. No. 2.
156	....do.......	....	09 53.0	14 40	....	
157	....do.......	....	12 58 0	15 30	....	
158	....do.......	....	14 06.0	15 15	....	
159	....do.......	....	17 06.5	13 00	....	
160	....do.......	....	18 15.8	11 35	....	
161	June 10......	Sun's lower	8 11 49.5	133 24 15	....	Sext. No. 1.
162	....do.......	limb.	12 56.6	24 40	....	Off 31′ 40″.
163	....do.......	....	21 47.0	23 00	....	On 31′ 22″.
164	....do.......	....	22 29.0	23 20	....	
165	....do.......	....	23 13.0	21 10	....	
166	June 11......	Sun's lower	8 26 18.7	133 31 20	....	Sext. No. 1.
167	....do	limb.	27 12.0	29 20	....	Sun surrounded by clouds.
168	....do.......	....	27 01.8	27 50	....	For index err. see time obs'n.
169	June 13......	Sun's lower	8 26 24.7	133 32 00	....	Sext. No. 1.
170	....do.......	limb.	42 37.3	32 45	....	Off 29′ 00″.
171	....do.......	....	43 38.0	29 20	....	On 33′ 50″.
172	....do.......	....	44 15 7	27 35	....	
173	....do.......	....	44 48.8	25 25	....	
174	....do.......	....	8 32 04 4	133 47 50	....	Sext. No. 2.
175	....do.......	....	35 49.0	43 30	....	Off 32′ 10″.
176	....do.......	....	38 20.2	39 10	....	On 30′ 50″.
177	....do.......	....	39 10.0	37 50	....	
178	June 14......	Sun's lower	8 27 54.0	133 54 10	....	Sext. No. 1.
179	....do.......	limb.	28 48.2	55 00	....	Off 31′ 40″.
180	....do....	....	33 05.8	56 50	....	On 31′ 35″.
181	....do.......	....	34 13.5	56 20	....	
182	....do.......	....	37 33.0	54 10	....	

Sextant observations.—Continued.

NEW FORT WALLA-WALLA. O

No.	Date.	Object.	Sid. chron. 525.			Double altitude.			Resulting meridian, double altitude.	Remarks.
	1859.		h.	m.	s.	°	′	″		
183	June 14	Sun's lower limb.	8	38	11.2	133	53	30		No. 178 to 183 have been corrected by + 10′.
184	do			42	04.0		48	00		
185	do			43	27.3		45	00		
186	do			44	30.8		42	30		
187	do			48	22.8		31	40		
188	do		8	30	47.0	133	54	20		Sext. No 2; index err. + 40″. Nos. 188 and 189 corrected by + 10′.
189	do			31	51.2		54	45		
190	do			39	07.4		51	00		
191	do			40	41.0		48	40		
192	do			45	26 5		38	20		
193	do			46	21.4		36	00		
194	do			47	11.0		33	45		
195	June 16	Sun's lower limb.	8	35	14.0	134	03	10		Sext. No. 1. Off 31′ 30″. On 31′ 40″. By artificial horizon. Off 31′ 10″. On 32′ 10″.
196	do			35	58.8		04	10		
197	do			37	00.7		05	15		
198	do			40	21.0		07	10		
199	do			41	10.2		07	00		
200	do			42	45.8		06	55		
201	do			46	34.0		04	20		
202	do			47	46.4		03	50		
203	do			48	18.7		02	05		
204	do		8	37	53.2	134	04	00		Sext. No. 2. By art. horizon. Off 31′ 15″. On 30′ 20″.
205	do			38	50.0		05	00		
206	do			39	41.6		05	05		
207	do			43	43 0		04	40		
208	do			44	18.6		04	15		
209	do			44	56.5		03	50		
210	June 16, p. m.	Polaris	19	44	55.0	90	24	00		Sext. No. 1. Index error as determined by Polaris — 5″.
211	do			47	39.5		25	05		
212	do			50	10.5		27	00		
213	do		19	54	18.0	90	28	00		Sext. No. 2. Index error by Polaris + 30″.
214	do			56	12.2		29	00		
215	do			58	52.5		30	50		
216	do	α Ophiuchi	20	40	48.5	113	06	45		Sext. No. 1.
217	do			43	13.5		02	40		
218	do		20	45	47.0	112	56	05		Sext. No. 2.
219	do			47	40.3		51	20		
220	June 17	Sun's lower limb.	8	40	05.0	134	08	00		Sext. No. 1. Off 31′ 40″. On 31′ 40″.
221	do			41	12.0		09	00		
222	do			42	39.5		10	20		
223	do			50	50.0		07	50		
224	do			51	43.8		06	45		
225	do			52	29.5		05	40		
226	do		8	44	06.3	134	08	50		Sext. No. 2. Off 32′ 20″. On 30′ 40″.
227	do			48	32.0		08	00		
228	do			49	33.5		07	20		
229	do			54	50.5	133	59	40		
230	do			55	58.3		57	35		
231	do			56	54 0		55	40		
232	June 18	Sun's lower limb.	8	36	36.0	133	55	50		Sext. No. 1. Off 31′ 30″. On 31′ 40″.
233	do			37	49.5		59	00		
234	do			39	40 2	134	03	30		
235	do			51	07.3		13	40		
236	do			52	12.0		13	10		
237	do			52	58.0		12	30		

Sextant observations—Continued.

NEW FORT WALLA-WALLA. O

No.	Date.	Object.	Sid. chron. 525.			Double altitude.			Resulting meridian, double altitude.	Remarks.
	1859.		h.	m.	s.	°	′	″		
238	June 18	Sun's lower limb.	8	43	09.5	134	07	20		Sext. No. 2.
239	do			45	50.3		10	20		Off 32′ 20″.
240	do			47	28.5		11	30		On 30′ 50″.
241	do			53	58.5		10	10		
242	do			54	43.0		09	10		
243	do			56	17.4		07	30		
244	June 19	Sun's lower limb.	8	43	26.0	134	04	30		Sext. No. 1.
245	do			44	23.0		06	50		Off 31′ 20″.
246	do			45	28.5		08	55		On 31′ 30″.
247	do			50	33.0		14	50		
248	do			51	34.0		15	20		
249	do			52	10.7		15	40		
250	do			57	06.0		14	45		
251	do			58	11.0		13	50		
252	do			58	53.0		13	10		
253	do		9	02	49.0		07	10		
254	do			03	27.7		05	55		
255	do			04	10.3		04	30		
256	do		8	48	13.0	134	11	00		Sext. No. 2.
257	do			49	10.0		12	00		
258	do			49	54.5		12	50		
259	do			53	40.2		14	20		
260	do			54	39.0		14	15		
261	do			55	22.5		14	10		
262	do			59	56.5		10	30		
263	do		9	00	30.0		09	20		
264	do			01	24.8		08	10		
265	June 20	Sun's lower limb.	8	45	46.0	134	01	20		Sext. No. 1.
266	do			46	31.0		03	35		Off 31′ 20″.
267	do			47	13.0		05	00		On 31′ 35″.
268	do			52	38.5		14	30		June 20, p.m., observed at 18h. 55m. the distant of α Virginis to α Scorpii, 45° 53′ 10″
269	do			53	24.0		15	20		
270	do			54	19.0		16	00		
271	do		9	00	14.0		17	00		Computed .... 45° 53′ 53″
272	do			01	38.0		15	50		
273	do			02	15.5		15	20		Diff. or sum of all corr. of sext.... +43″
274	do			07	04.5		08	50		
275	do			08	38.0		05	00		
276	do			09	33.5		02	40		
277	do			10	10.5		01	00		
278	do		8	49	56.0	134	08	40		Sext. No. 2.
279	do			50	48.5		10	10		Off 32′ 20″ 32′ 20″.
280	do			51	31.0		11	10		On 30′ 30″ 30′ 35″.
281	do			55	06.0		14	50		
282	do			56	24.0		15	25		
283	do			57	31.0		15	35		
284	do		9	03	27.0		12	30		
285	do			04	11.5		11	30		
286	do			05	19.5		10	20		
287	June 22.	α Serpentis	18	33	30.5	101	36	40		Sext. No. 1.
288	do			37	21.5		38	20		Comparison before observation.
289	do			39	10.0		39	00		
290	do			43	48.0	Rej.				525, 18h. 11m.
291	do			47	46.0		35	50		7961, 3h. 51m. 10.5s.
292	do			49	49.0		33	30		
293	do			51	42.4		30	00		
294	do			54	35.2		24	00		
295	do	Polaris, L. C.	19	07	09.2	90	02	30		Sext. No. 1.
296	do			13	07.5		05	30		Comparison after the observation.
297	do			16	11.5		07	20		
298	do			21	44.0		10	50		525, 20h. 31m.
299	do			26	54.0		12	50		7961, 7h. 10m. 46.2s.
300	do			32	43.5		16	30		½ minute later, 11m. 16.7s.
301	do	β Ursæ Min..	19	41	20.7	121	18	50		The name of object doubtful. The observations were intended for β Ursæ Minoris.
302	do		20	03	26.3	116	14	30		
303	do			05	25.8		02	30		

Sextant observations—Continued.

CAMP ON DRY CREEK.

OBSERVATIONS FOR TIME AND LATITUDE.

No.	Date.	Chron. 7961.			Double altitude, sextant 2. ☉			Remarks.
	1859.	h.	m.	s.	°	'	"	
1	June 23	5	52	48.5	114	30	00	Observations for variation of compass.
2	....do....		53	24.0		40	00	
3	....do....		53	58 3		50	00	
4	....do....		54	33.3	115	00	00	
5	....do....		55	08.4		10	00	
6	....do....		55	43.4		20	00	
7	....do....		56	18.6	115	30	00	
8	....do....	7	44	33.5	134	02	00	
9	....do....		45	23.8		02	50	
10	....do....		46	41.7		03	17	
11	....do....		48	33.5		03	20	
12	....do....		49	26.0		03	10	
13	....do....		50	19.0		03	00	
14	....do....		51	51.5		02	00	
15	....do....		52	42.7		01	20	
16	....do....	9	57	58.7	110	20	00	
17	....do ..		58	31.7		10	00	
18	....do....		59	05.4		00	00	
19	....do....		59	37.8	109	50	00	
20	....do....	10	00	13.2		40	00	
21	....do....		00	44.0		30	00	
22	....do....		01	16.0		20	00	

CAMP ON TOUCHET.

OBSERVATIONS FOR TIME AND LATITUDE.

No.	Date.	Chron. 7961.			Double altitudes, ☉ Sext. No. 2.			Remarks.
	1859.	h.	m.	s.	°	'	"	
1	June 24	6	14	26.7	120	10	00	Off 32' 20".
2	....do....		14	66.0		20	00	On 30' 30".
3	....do....		15	44.8		30	00	
4	....do....		16	23.2		40	00	This station is different from that of the same name on May 18.
5	....do ..		17	05.0		50	00	
6	....do....		17	45.0	121	00	00	
7	....do....		18	24.2		10	00	
8	....do....	7	48	08.5	133	44	00	
9	....do....		49	50 3		43	50	
10	....do....		53	04.0		41	30	
11	....do....		53	33.5		41	20	
12	....do....		55	39.2		38	20	
13	....do....		56	59.2		35	40	
14	....do....		58	40.5		32	30	Approx.
15	....do....	9	27	12.2	118	50	00	
16	....do....		27	51.3		40	00	
17	....do....		28	27.8		30	00	
18	....do....		29	06 5		20	00	
19	....do....		29	43.3		10	00	
20	....do....		30	21.0		00	00	
21	....do....		30	58.5 ?	117	50	00	

No.	Date.	Eq. double altitudes, ☉ Sext. No. 2.		Chron. 7961, a. m.			Chron. 7961, p. m.			Mean.			Remarks.
	1859.	°	"	h.	m.	s.	h.	m.	s.	h.	m.	s.	
22	June 25	100	30	5	07	40.8	10	28	50.7	7	48	20.3	
23	....do....		40		08	11.2		28	29.4			20.3	
24	....do....		50		08	42.7 ?		27	57.7			20.2	
25	....do....	101	30		10	46.8		25	52.2			19.5	
26	....do....		40		10	17.7		25	22.3			20.0	
27	....do....		50		11	49.2		24	50.8 ?			20.0	
28	....do....	102	00		11	20.4		24	19.5			20.0	
29	....do....		10		12	52.2		23	47.3			19.8	
30	....do....		20		12	23.7		23	16.8			20.2	

Sextant observations.—Continued.

CAMP ON TOUCHET.

No.	Date.	Object.	Chron. 7961 and 525.			Double altitudes, sext. No. 2.			Remarks.
	1859.		*h.*	*m.*	*s.*	°	′	″	
31	June 25	Sun's lower limb.	5	04	03.2	99	20	00	Chron. 7961.
32	....do....			04	33.8		30	00	
33	....do....	....		10	14.8	101	20	00	
34	....do....	....		13	54.0	102	30	00	
35	....do....	....		18	31.0	103	50	00	
36	....do....	....		20	07.5		20	00	
37	....do....	....		20	39.2		10	00	
38	....do....	....		21	11.3		00	00	
39	June 25..	β Ursæ Min..	19	20	19.8	126	17	50	Chron. 525.
40	....do....	....		22	10.2		12	30	Comparison, 525.... 19*h.* 50*m.* 00.0*s.*
41	....do....	....		24	14.3		05	20	7961.... 6*h.* 17*m.* 37.0*s.*
42	....do....	....		26	12.8	125	58	10	
43	....do....	....		28	30.2		48	10	
44	June 25..	Polaris......	19	32	34.6	90	45	10	Chron. 525.

CAMP AT HEAD OF REED CREEK.

OBSERVATIONS FOR TIME AND LATITUDE.

No.	Date.	Chron. 7961.			Double altitudes, ☉ Sext. No. 2.			Remarks.
	1859.	*h.*	*m.*	*s.*	°	′	″	
1	June 26..	7	46	24.8	133	28	20	Off 32′ 20″.
2	....do....		47	37.6		28	40	On 30′ 40″.
3	....do....		49	14.0		28	20	
4	....do....		50	13.5		28	00	
5	....do....		50	56.0		27	40	
6	....do....		51	29.8		27	10	
7	....do....		52	14.8		26	20	
8	....do....		52	57.5		26	00	
9	....do....	1	17	08.2	43	10	00	
10	....do....		19	04.3	42	30	00	
11	....do....		19	34.8		20	00	
12	....do....		20	05.2		10	00	
13	....do....		21	04.0	41	50	00	
14	....do....		21	33.8		40	00	
15	....do....		21	03.0		30	00	

FORT TAYLOR.

OBSERVATIONS FOR TIME AND LATITUDE.

No.	Date.	Object.	Chron.			Double alt's, sext. No. 2.			Remarks.
	1859.		*h.*	*m.*	*s.*	°	′	″	
1	June 27, p. m.	Sun's lower limb.	0	02	37.3	68	40	00	Chron. 7961.
2	......do......			03	08.7		30	00	
3	......do......	....		03	37.2		20	00	Station at the door of the old fort west of tower.
4	......do......	....		04	06.5		10	00	
5	......do......	....		04	34.5		00	00	
6	......do......	....		05	03.2	67	50	00	The observations are made under unfavorable circumstances; heavy gust and dust; disturbance from people.
7	......do......	....		05	32.8		40	00	
8	......do......	....		08	57.8	66	30	00	
9	......do......	....		09	26.8		20	00	
10	......do......	....		09	55.0		10	00	
11	......do......	....		10	25.2		00	00	
12	......do......	....		10	53.7	65	50	00	
13	......do......	....		11	23.0		40	00	
14	......do......	....		11	51.8		30	00	
15	......do......	....		12	20.2		20	00	

Sextant observations—Continued.

FORT TAYLOR.

No.	Date.	Object.	Chron.			Double alt's, Sext. No. 2.			Remarks.
			h.	m.	s.	°	′	″	
	1859.								
16	June 27, p. m	Polaris	19	53	03.0	91	27	50	Sid. chron. 525.
17	do			54	57.5		29	10	The star observations are made 100 feet south of tower.
18	do			57	04.2		30	00	
19	do			59	19.4		31	20	
20	do		20	00	52.3		32	10	
21	June 27, p. m.	α Herculis	20	11	42.5	116	00	00	
22	do			13	53.5	115	59	30	
23	do			16	51.8		57	40	
24	do			18	34.2		55	30	
25	do			19	54.0		53	20	
26	June 27, p. m	ε Ursæ Min.	20	31	35.3	108	28	00	
27	do			35	07.5		25	35	
28	do			38	18.7		22	50	
29	do			42	22.5		20	50	
30	do			46	50.0		17	10	

No.	Date.	Eq. double altitude, ☉ Sext. No. 2.		Chron. 7961, a. m.			Chron. 7961, p. m.			Mean.			Remarks.
		°	′	h.	m.	s.	h.	m.	s.	h.	m.	s.	
	1859.												
31	June 28	76	20	3	55	49.3							Observations 190 feet south of tower, on a place like an island, at the mouth of Tucañon.
32	do		30		56	20.0							
33	do		40		56	49.2							
34	do		50		57	19.3							
35	do	77	00		57	47.3							
36	do		10		58	17.0							
37	do		20		58	45.6	11	37	18.0	7	48	01.8	
38	do		30		59	15.0?		36	48.2			01.6	
39	do		40		59	43.8		36	18.5			01.2	
40	do		50	4	00	13.4		35	49.0			01.2	
41	do	78	00		00	42.7		35	19.7			01.2	
42	do	79	00		03	38.7							
43	do		10		04	09.0							Mosquitoes.
44	do		20		04	37.8							
45	do		30		05	07.0							
46	do		40		05	36.2							
47	do		50		06	06.5							
48	do	80	00		06	35.5							

No.	Date.	Chron. 7961.			Double altitude, sextant No. 2, ☉			Resulting meridian, double altitudes.	Remarks.
		h.	m.	s.	°	′	″		
	1859.								
49	June 28	7	41	45.8	132	52	40		Off 32′ 20″.
50	do		43	32.0		54	50		On 30′ 30″.
51	do		44	57.0		56	10		
52	do		46	33.2		56	50		
53	do		49	30.2		56	40		
54	do		51	33.8		55	40		Observation for magnetic variation.
55	do		53	03.0		54	20		
56	do		53	53.0		53	30		
57	do		54	48.7		52	20		

Sextant observations—Continued.

FORT TAYLOR.

OBSERVATIONS FOR LATITUDE.

No.	Date.	Object.	Time by chron. 525.	Double altitude by sextant No. 2.	Resulting meridian, double altitude.	Remarks.
	1859.		h. m. s.	° ′ ″		
58	June 30, p. m.	Polaris	19 37 56.0	91 18 50	....	Observations 100 feet south of tower.
59	....do........	....	41 45.0	20 30	....	
60	....do........	....	44 40.5	22 05	....	
61	....do........	....	46 47.7	23 40	....	
62	....do........	....	48 42.0	24 50	....	
63	June 30, p. m.	α Herculis...	19 55 52.3	115 40 30*	....	* Shaking the sextant.
64	....do........	....	58 13.6	45 00	....	
65	....do........	....	20 02 18.4	52 40	....	
66	....do........	....	08 26.8	58 40	....	
67	....do........	....	12 44.7	59 20	....	
68	....do........	....	15 39.0	58 40	....	
69	....do........	....	18 52.8	55 20	....	
70	....do........	....	23 01.3	46 30	....	
71	....do........	....	26 05.2	42 00	....	Aneroid 29.58, 62°.5.

OBSERVATIONS FOR TIME AND LATITUDE.

No.	Date.	Double eq. altitude, ⊙ Sextant No. 2.	Chron. 7961, a. m.	Chron. 7961, p. m.	Mean.	Remarks.
	1859.	° ′	h. m. s.	h. m. s.	h. m. s.	
72	July 1	81 00	4 10 19.3	11	7 48 ...	Observation 120 feet south of fort.
73	....do....	20	11 18.8	....	....	
74	....do....	30	....	24 28.6	....	
75	....do....	40	12 18.0	23 57.8	07.9	
76	....do....	50	12 47.2	....	....	
77	....do....	82 00	13 16.8	....	....	
78	....do....	83 00	4 16 14.7	20 01.8	08.2	
79	....do....	10	16 43 3	19 31.7	07.5	
80	....do....	20	....	19 02.8	....	
81	....do....	30	....	18 33.2	....	
82	....do....	40	....	18 03.5	....	
83	....do....	50	18 41.0	17 36.0	08.5	Sun appeared flat.
84	....do....	84 00	19 10.6	17 05.8	08.2	

No.	Date.	Chron. 7961.	Double altitude, ⊙ sext. No. 2.	Resulting meridian, double altitude.	Remarks.
	1859.	h. m. s.	° ′ ″		
85	July 1	7 42 48.0	122 33 10	....	Observation 120 feet south of fort.
86	....do....	43 47.5	34 40	....	
87	....do....	45 18.0	35 30	....	
88	....do....	46 33.8	36 30	....	
89	....do....	48 20.3	36 40	....	
90	....do....	49 37.0	36 30	....	
91	....do....	50 34.0	36 00	....	
92	....do....	52 05.5	35 00	....	
93	....do....	54 37.2	33 30	....	

Sextant observations—Continued.

FORT TAYLOR.

OBSERVATIONS FOR TIME BY EQUAL ALTITUDES OF ☉

Date.	Double equal altitudes of Venus by sid. chron. 525, Eggert & Son, maker.							Mean.
	84° 10′.	84° 20′.	84° 30′.	84° 40′.	84° 50′.	85° 00′.	85° 10′.	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
July 2, a. m.	6 18 52.4	19 21.5	19 51.4	20 21.3	20 51.2	21 20.8	21 50.0	
Mean	9 47 38.4	38.3	....	37.8	37.9	37.9	37.4	37.9
July 2, p. m.	13 16 24.5	15 55.0	....	14 54.3	14 24.6	13 55.0	13 24.8	
Mean	21 49 53.2	52.6	....	52.3	52.3	52.4	52.6	52.6
July 3, a. m.	6 23 21.8	23 50.2	24 20.4	24 50.3	25 20.0	25 49.7	25 20.3	
Mean	9 51 48.4	47.7	47.7	47.9	47.9	47.9	48.1	47.9
July 3, p. m.	13 20 15.0	19 45.2	19 15.0	18 45.5	18 15.8	17 46.1	17 16.0	

Date.	Double equal altitudes by sol. chron. 7961, Arnold Chs. Frodsham.							Mean.
	86° 00′.	86° 10′.	86° 20′.	86° 30′.	86° 40′.	86° 50′.	87° 00′.	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
July 2, a. m.	4 25 28.2	25 58.5	26 28.7	26 58.8	27 29.3	27 58.0	28 28.8	
Mean	7 48 . . .	11.6	11.8	11.9	12.5	11.9	12.4	12.0
July 2, p. m.	11 10 . . .	10 24.7	09 55.0	09 25.0	08 55.8	08 25.8	07 56.0	
Mean	7 48 . . .	24.3	....	23.4	23.8	23.7	23.3	23.7
July 3, a. m.	4 25 53.0	26 24.0	....	27 21.8	27 51.7	28 21.6	28 50.6	
Mean	7 48 17.2	37.7	....	16.8	16.8	17.4	16.5	17.1
July 3, p. m.	11 10 41.3	10 11.5	....	09 11.8	08 41.8	08 13.2	07 42.3	

Date.	Double equal altitude by sol. chron. 158, Jas. Dalles, maker.							Mean.
	88° 00′.	88° 10′.	88° 20′.	88° 30′.	88° 40′.	88° 50′.	89° 00′.	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
July 2, a. m.	4 34 34.8	35 05.4	35 35.4	36 06.0	36 34.8	37 05.2	37 36.1	
Mean	7 51 20.2	20.3	20.7	20.5	20.0	20.3	20.8	20.4
July 2, p. m.	11 08 05.5	07 35.3	07 06.0	06 35.1	06 05.2	05 35.4	05 05.6	
Mean	7 51 . . .	30.1	30.7	30.5	30.4	....	....	30.4
July 3, a. m.	4 34 . . .	35 24.9	35 55.4	36 25.8	36 55.5	....	....	
Mean	7 51 . . .	19.6	19.9	20.3	20.7	....	....	20.1
July 3, p. m.	11 07 . . .	07 14.3	06 45.4	06 14.8	05 46.0	05 14.3	04 44.8	

Date.	Double equal altitude by sol. chron. 8544, Arnold Chs. Frodsham.							Mean.
	90° 00′.	90° 10′.	90° 20′.	90° 30′.	90° 40′.	90° 50′.	91° 00′.	
1859.	h. m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
July 2, a. m.	4 51 04.2	51 34.7	52 04.5	52 31.6	53 05.8	53 35.3	54 05.8	
Mean	8 01 50.0	51.3	51.0	50.9	51.4	51.2	50.8	50.0
July 2, p. m.	11 12 37.0	12 07.9	11 37.4	11 07.2	10 37.0	10 07.2	09 35.8	
Mean	8 02 08.0	08.8	....	09.0	08.9	09.2	08.6	08.6
July 3, a. m.	4 51 39.0	52 09.7	....	53 10.8	53 40.8	54 11.2	54 41.3	
Mean	8 02 06.2	06.5	....	07.3	....	....	....	06.7
July 3, p. m.	11 12 33.3	12 03.2	11 32.7	11 03.8	....	....	....	

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
July 5, p. m.	Peluse, 2d camp	α Aquilæ	22 38 15.0		105 20 30		Chron. 525.
Do.	do	do	40 26.7		22 30		Sext. No. 2.
Do.	do	do	43 37.8		24 20		Index error, +40″.
Do.	do	do	47 51.7		24 30		
Do.	do	do		22 51 20.4	22 50		
Do.	do	do		53 30.5	21 50		
Do.	do	do		56 11.8	17 50		
July 6, a. m.	do	do		23 55 27.8	97 55 50		
Do.	do	do		57 12.0	38 40		
Do.	do	do		59 06.8	20 30		
Do.	do	do		0 01 42.0	96 54 20		
Do.	do	Polaris	0 06 09.5		94 56 30		
Do.	do	do	08 13.8		58 10		
Do.	do	do	11 02.3		95 00 15		
Do.	do	do	13 23.8		01 30		
Do.	do	do	15 12.5		03 05		
Do.	do	do	18 23.0		05 10		
July 10	Peluse, 4th camp	Sun's lower limb	6 43 45.4	8 51 25.8	123 50 00	7 47 35.6	Chron. 7961.
Do.	do	do	44 37.6	50 30.0?	124 00 00	33.8	
Do.	do	do	45 34.8	49 35.2	10 00	35.0	
Do.	do	do	46 29.8	48 43.0	20 00	36.4	
Do.	do	do	47 25.7	47 48.0	30 00	36.8	
Do.	do	do	48 23.0	46 50.5	40 00	36.7	
Do.	do	do	49 18.0	45 51.7	50 00	34.9	
Do.	do	do	50 15.4	44 54.5	125 00 00	35.0	
Do.	do	do	51 14.3	43 54.8	10 00	34.6	
Do.	do	do	52 14.7	42 55.8	20 00	35.3	
Do.	do	do	7 45 59.0		130 08 50		
Do.	do	do		7 48 06.5	09 20		
Do.	do	do		51 19.0	08 10		
Do.	do	do		52 15.0	07 20		
Do.	do	do		53 09.8	06 30		
Do.	do	do		54 02.0	05 20		
Do.	do	do		55 07.0	03 50		
Do.	do	do		56 36.8	01 20		
July 10, p. m.	do	Polaris	21 10 33.0		93 02 10		Chron. 525.
Do.	do	do	12 59.5		04 10		Sext. No. 2.
Do.	do	do	14 31.5		05 25		Index error, +40″.
Do.	do	do	16 07.5		08 30		

Do.	do	do	17 07.0		07 30		
Do.	do	Arcturus		21 30 00.6	69 31 10		
Do.	do	do		33 42.5	61 57 00		
Do.	do	do		34 45.3	36 20		
Do.	do	do		36 12.0	06 00		
Do.	do	do		37 44.2	60 35 00		
July 11.	Oreteus, camp.	Sun's lower limb		7 51 46 0	129 31 30		
Do.	do	do		52 37.0	30 20		
Do.	do	do		53 28.5	29 30		
Do.	do	do		53 58.5	29 00		
Do.	do	do		54 45.8	28 00		
Do.	do	do		55 19.4	27 00		
Do.	do	do		55 53.0	26 10		
Do.	do	do		56 19.7	25 20		
Do.	do	do		12 02 25.8	66 50 00		
Do.	do	do		02 54.2	40 00		
Do.	do	do		03 25.0	30 00		
Do.	do	do		03 53.2	20 00		
Do.	do	do		04 22.7	10 00		
Do.	do	do		04 51.6	66 00 00		
Do.	do	do		05 22.0	65 50 00		
Do.	do	do		05 50.8	40 00		
Do.	do	do		06 20.2	30 00		
Do.	do	do	6 30 17.8	9 02 58.0	120 20 00	7 46 07.9	Chron. 7961.
July 12.	Toho-toho-u-see-pe	do	31 05.6	02 09.8	30 00	07.6	
Do.	do	do	31 54.5	01 21.0	40 00	07.8	
Do.	do	do	32 43.3	00 32.7	50 00	08.0	
Do.	do	do	33 32.5	8 59 44.5	121 00 00	08.5	
Do.	do	do	34 23.8	58 53.8	10 00	08.8	
Do.	do	do	35 12.8	58 03.5	20 00	08.2	
Do.	do	do	7 45 10.8		128 56 30		
Do.	do	do		7 46 33 6	56 40		
Do.	do	do		47 38.0	56 45		
Do.	do	do		48 52.2	56 30		
Do.	do	do		49 45.5	56 00		
Do.	do	do		50 52.0	55 20		
Do.	do	do		51 43.8	54 20		
Do.	do	do		52 28.3	53 30		
Do.	do	dp		53 12.7	52 40		
July 13, p. m.	Sil-sei-pow-vet-sin.	Arcturus		20 12 35.8	88 18 00		Chron. 525.
Do.	do	do		13 57.8	87 51 00		
Do.	do	do		16 19/8	05 50		
Do.	do	do		18 03.2	86 33 20		
Do.	do	do		19 09.7	11 30		
Do.	do	Polaris	20 22 25.3		93 21 50		
Do.	do	do	24 26.7		23 20		
Do.	do	do	26 05.8		24 20		
Do.	do	do	27 53.2		25 30		
Do.	do	α Ophiuchi		20 31 41.7	110 38 40		Index error, +48″.
Do.	do	do		34 06.2	37 30		
Do.	do	do		35 30.0	35 30		
Do.	do	do		36 34.7	34 40		
Do.	do	do		37 39.8	32 45		

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
July 14, p. m.	Lahtoo	Polaris	20 16 54.5		93 24 50		
Do.	do	do	18 24.5		26 10		
Do.	do	do	19 09.0		26 50		
Do.	do	do	19 59.0		27 20		
Do.	do	do	20 47.3		28 10		
Do.	do	do	22 37.3		29 20		
Do.	do	α Ophiuchi	20 24 31.5	20 32 58.0	110 31 00		
Do.	do	do	26 12.0		31 40		
Do.	do	do	27 08.5		31 50		
Do.	do	do	28 34.0		32 00		
Do.	do	do		20 29 48.5	32 05		
Do.	do	do		20 31 24.9	110 31 45		
Do.	do	do		34 34.8	30 00		
Do.	do	do		35 44.0	29 00		
Do.	do	Arcturus		40 24.8	78 55 30		Through trees.
Do.	do	do		43 35.0	51 00		
Do.	do	α Aquilæ	20 46 19.7		87 38 10		
Do.	do	do	47 39.6		56 00		
Do.	do	do	48 49.5		88 12 00		
Do.	do	do	49 51.0		25 40		
Do.	do	do	50 49.6		38 40		
Do.	do	do	51 47.5		51 50		
July 15, p. m.	Lo-chuis	Polaris	20 30 56.0		93 37 00		
Do.	do	do	32 15.0		38 40 ?		
Do.	do	do	33 32.0		39 00		
Do.	do	do	34 36.0		40 20		
Do.	do	do	35 46.0		40 50		
Do.	do	do	36 53.5		41 40		
Do.	do	do	38 52.5		43 00		
July 16.	In-chats-chan, 500 feet, W.NW. from camp in 1858.	Sun's lower limb	4 56 55.4		94 50 00		Chron. 7961.
Do.	do	do	57 28.0		95 00 00		
Do.	do	do	58 01.8		10 00		
Do.	do	do	58 32.0		20 00		
Do.	do	do	59 04.6		30 00		
Do.	do	do	5 01 15.7		96 10 00		
Do.	do	do	01 40.0		20 00		
Do.	do	do	02 20.4		30 00		
Do.	do	do	02 53.9		40 00		

Do.	do	do	5 03 25.0		96 20 20		Chron. 525. Index error, +48″.
Do.	do	do	03 57.2		97 00 00		
Do.	do	α Ophiuchi		20 29 26.0	110 30 20		
Do.	do	do		30 27.0	30 00		
Do.	do	do		31 26.5	29 20		
Do.	do	do		32 32.0	28 30		
Do.	do	do		33 45.0	27 00		
Do.	do	Arcturus		20 35 59.5	79 52 20		
Do.	do	do		36 51.0	34 20		
Do.	do	do		38 17.3	06 20		
Do.	do	do		39 44 0	78 36 50		
Do.	do	do		40 57.8	13 10		
Do.	do	Polaris	20 43 22.0		93 44 30		
Do.	do	do	44 50.0		45 50		
Do.	do	do	46 38.5		46 30		
Do.	do	do	48 00.5		47 10		
Do.	do	do	49 18.0		48 30		
Do.	do	do	50 37.0		49 10		
July 17.	do	Sun's lower limb		7 44 11.3	197 05 35		Chron. 7961.
Do.	do	do		44 54.3	05 20		
Do.	do	do		46 04.0	05 00		
Do.	do	do		46 50.5	04 25		
Do.	do	do		48 37.3	03 10		
Do.	do	do		49 19.5	02 30		
July 18.	do	do	5 51 57.0	9 35 07.0	110 10 00	7 43 32.0	
Do.	do	do	52 36.5	34	20 00		
Do.	do	do	53 13.8	33 48.5	30 00	31.2	
Do.	do	do	53 52.3	33 11.0	40 00	31.7	
Do.	do	do	54 31.2	32 31.8	50 00	31.5	
Do.	do	do	55 09.7	31 53.2	111 00 00	31.4	
Do.	do	do	55 47.8	31 14.5	10 00	31.2	
Do.	do	do	7 37 58.0		126 41 40		
Do.	do	do	38 36.0		42 40		
Do.	do	do	39 15.0		43 30		
Do.	do	do	40 02.7		44 00		
Do.	do	do	40 40.5		44 20		
Do.	do	do	41 46.0		44 40		
Do.	do	do	42 47.0		44 40		
Do.	do	do	44 00.0	7 44 35.7	44 30		
Do.	do	do		46 13.5	44 10		
Do.	do	do		47 04.0	43 40		
July 20.	do	do	3 31 51.0		56 00 00		
Do.	do	do	32 21.0		10 00		
Do.	do	do	32 49.8		20 00		
Do.	do	do	33 20.3		30 00		
Do.	do	do	33 50.3		40 00		
Do.	do	do	34 20.5		50 00		
Do.	do	do	34 49.8		57 00 00		
Do.	do	do	35 18 7		10 00		
Do.	do	do	35 48 6		20 00		
Do.	do	do	36 18.2		30 00		
Do.	do	do	36 47.3		40 00		
July 22.	do	do	5 20 26.5	10 06 03.5	100 20 00	7 48 16.0	

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
July 22	Ins-chate-chan	Sun's lower limb	5 21 03.6	10 05 28.0	100 30 00	7 48 15.8	
Do.	do	do	21 38.2	04 53.8	40 00	16.0	
Do.	do	do	22 13.0	04 19.8	50 00	16.4	
Do.	do	do	22 47.2	03 45.6	101 00 00	16.4	
Do.	do	do	23 22.5	03 11.3	10 00	16.9	
Do.	do	do	23 56.8	02 35.8	20 00	16.3	
Do.	do	do	24 31.7	02 00.5	30 00	16.1	
Do.	do	do	25 06.7	01 27 2	40 00	16.9	
Do	do	do	25 41.3	00 52.1	50 00	16.7	
July 28	St. Joseph's river, upper camp	do	25 16.0	9 59 04.4	100 00 00	7 42 10.2	On shore 600 feet below the post marked M. R., 169 miles.
Do.	do	do	25 50.8	58 29.5	10 00	10.2	
Do.	do	do	26 26 0	57 53.8	20 00	09.9	
Do.	do	do	27 00.7	57 18.3	30 00	09.5	
Do.	do	do	27 38.0	56 42.2	40 00	10.1	
Do.	do	do	28 13.2	56 05.7	50 00	09.5	
Do.	do	do	28 48.0	55 29.8	101 00 00	08.9	
Do.	do	do	30 37.7	53 42.3	30 00	10.0	
Do.	do	do	31 15.0	53 06.8	40 00	10.9	
Do.	do	do	31 51.2	52 30.2	50 00	10.6	
Do.	do	do	32 28.0	51 53.3	102 00 00	10.6	
Do.	do	do	33 05.3	51 17.0	10 00	11.1	
Do.	do	do		7 42 22.7	122 44 20		Off 32′ 20″.
Do.	do	do		44 44.5	43 30		On 30′ 30″.
Do.	do	do		45 50.0	43 00		
Do.	do	do		46 47.3	42 30		
Do.	do	do		48 06.7	41 00		
Do.	do	do		49 28.0	39 10		
Do.	do	do		50 32.2	37 50		
Do.	do	Polaris	22 03 13.8		94 39 50		Chron. 525.
Do.	do	do	05 59.5		41 00		
Do.	do	do	07 28.7		41 40		At camp.
Do.	do	do	09 25 0		43 20		
Do.	do	do	11 02.0		44 40		
Do.	do	η Ursæ Major		22 20 26.4	73 52 30		
Do.	do	do		22 36.2	17 10		
Do.	do	do		24 40.8	72 43 50		
Do.	do	do		26 28.6	15 30		
Do.	do	do		28 09.8	71 47 10		
Do.	do	α Aquilæ	22 34 29.5		102 11 40		

Do.	do	do	22	36	[illegible]				108	14	50				
Do.	do	do		38	13.0					15	30				
Do.	do	do		40	09.0					16	10				
Do.	do	do				22	42	10.8		16	00?				
Do.	do	do					45	17.7		15	40				
July 30.	do	Sun's lower limb	4	28	07.2	10	55	55.2	82	00	00	7	42	01.2	Chron. 7961.
Do.	do	do		29	08.7		54	53.2		20	00			01.0	
Do.	do	do		29	40.2		54	21.8		30	00			01.0	Near shore.
Do.	do	do		30	11.0		53	50.0		40	00			00.5	
Do.	do	do		30	43.0		53	19.5		50	00			01.3	
Do.	do	do		31	15.4		52	47.7	83	00	00			01.6	
Do.	do	do		31	46.6		52	16.5		10	00			01.5	
Do.	do	do		32	18.0		51	45.2		20	00			01.6	
Do.	do	do		32	49.2		51	13.8		30	00			01.5	
Do.	do	do		33	20.8		50	42.0		40	00			01.4	
Do.	do	do	7	40	30.8				121	46	50				
Do.	do	do		41	24.0					47	20				
Do.	do	do		42	41.0					47	25				
Do.	do	do				7	45	33.2		46	20				
Do.	do	do					46	13.8		45	50				
Do.	do	do					47	02.5		45	10				
Do.	do	do					47	57.8		44	20				
Do.	do	do					48	59.2		43	20				
August 1.	Cœur d'Alêne river	do				16	31	38.2	50	10	00				Chron. 525.
Do.	do	do					32	08.0		00	00				
Do.	do	do					32	37.5	49	50	00				
Do.	do	do					33	07.8		40	00				Off 32' 25″.
Do.	do	do					33	36.2		30	00				On 30' 30″.
Do.	do	do					34	06 8		20	00				
Do.	do	do					34	37.2		10	00				
Do.	do	do					35	06.7		00	00				
Do.	do	do					35	36.0	48	50	00				
Do.	do	do					36	05.2		40	00				
Do.	do	do					36	34.6		30	00				
Do.	do	do					37	05.0		20	00				
Do.	do	do					37	35.0		10	00				
Do.	do	do					38	04.8	48	00	00				
Do.	do	Polaris	23	48	26.3				96	10	20				
Do.	do	do		49	45.0					10	30				
Do.	do	do		51	03.0					11	10				
Do.	do	do		52	31.5					11	50				
Do.	do	do		53	43.7					13	10				
August 3.	Mission	Sun's lower limb	10	19	04.3	13	21	01.0	108	50	00	11	50	02.6	Chronometer 525.
Do.	do	do		19	53.0		20	14.3	109	00	00			03.6	Sextant No. 2.
Do.	do	do		20	39.3		19	27.8		10	00			03.6	Off 32' 20″.
Do.	do	do		21	27.0		18	40.2		20	00			03.6	On 30' 30″.
Do.	do	do		22	15.2		17	52.4		30	00			03.8	
Do.	do	do		23	02.6		17	04.0		40	00			03.3	
Do.	do	do		23	51.3		16	15.4		50	00			03 4	
Do.	do	do		24	40.2		15	25.8	110	00	00			03.0	
Do.	do	do	11	31	43.5				118	56	10				
Do.	do	do		32	46.0					59	10				
Do.	do	do		34	36.2				119	04	00				

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			*h. m. s.*	*h. m. s.*	° ′ ″	*h. m. s.*	
August 3	Mission	Sun's lower limb	11 35 52.8		119 07 10		
Do.	do	do	36 48.3		09 10		
Do.	do	do	38 36.2		12 30		
Do.	do	do	39 44.0		15 00		
Do.	do	do	42 39.6		19 20		
Do.	do	do	44 10.0		20 50		
Do.	do	do	45 19.8		22 00		
Do.	do	do	46 29.2		22 45		
Do.	do	do	48 03.2		23 30		
Do.	do	do		11 50 11.5	23 50		
Do.	do	do		51 49.0	23 20		
Do.	do	do		53 52.3	22 20		
August 4	do	do	10 33 27.0	13 14 24.8	110 30 00	11 53 55.9	
Do.	do	do	35 11.2	12 41.0	50 00	56.1	
Do.	do	do	36 02.5	11 47.0	111 00 00	54.8	
Do.	do	do	36 52.3	10 56.0	10 00	54.2	
Do.	do	do	39 39.0	08 15.0	40 00	57.0	
Do.	do	do	11 47 20.3		118 48 50		
Do	do	do	48 52.0		50 10		
Do.	do	do		11 59 47.0	49 20		
Do.	do	do		12 01 38.0	47 20		
Do.	do	do		05 11.3	41 50		
Do.	do	do		06 04.2	39 50		
August 8	do	do	9 37 09.2	14 41 36.0	91 00 00	12 09 22.6	Sextant No. 2.
Do.	do	do	37 43.7	41 00.3	10 00		
Do.	do	do	38 53.6	39 50.5	30 00		
Do.	do	do	39 30.2	39 13.7	40 00		
Do.	do	do	40 05.2	38 39.0	50 00		
Do.	do	do	40 40.3	38 03.5	92 00 00		
Do.	do	do	41 15.4	37 28.0	10 00		
Do.	do	do	41 50.6	36 53.8	20 00		
Do.	do	do	42 26.5	36 16.5	30 00		
Do.	do	do	43 01.8	35 41.3	40 00		
Do.	do	do	43 37.3	35 05.2	50 00		
Do.	do	do	11 56 15.0		116 26 10		
Do.	do	do	57 42.0		29 20		
Do.	do	do	59 13.8		31 30		
Do.	do	do	12 00 59.7		34 10		

Do.	do	do	02 17.4		35 50		
Do.	do	do		12 17 50.0	33 30		
Do.	do	do		18 44.0	32 10		
Do.	do	do		19 50.8	30 40		
Do.	do	do		21 20.8	28 20		
Do.	do	do		22 03.6	27 00		
August 9	do	do	11 13 35.4	13 12 52.0?	111 30	12 13 13.7	
Do.	do	do	14 43.2	11 42.8	40 00	13.0	
Do.	do	do	15 51.8	10 34.0	50 00	12.9	
Do.	do	do	17 02.0	09 25.2	112 00 00	13.6	
Do.	do	do	18 14.3	08 12.0	10 00	13.2	
Do.	do	do	12 03 12.0		115 59 20		Sextant No. 1.
Do.	do	do	04 02.5		116 00 50		
Do.	do	do	04 33.0		01 40		Index error, + 6.0.
Do.	do	do		12 23 38.0	115 58 40		
Do.	do	do		24 12.3	57 30		
Do.	do	do		24 51.2	56 30		
Do.	do	do		25 28.0	55 10		
Do.	do	do		26 06.0	53 50		
Do.	do	do	12 05 52.2		116 01 20		Sextant No. 2.
Do.	do	do	06 30.0		01 50		
Do.	do	do	06 57.0		02 30		
Do.	do	do	07 38.7		03 00		
Do.	do	do	08 09.5		03 20		
Do.	do	do		12 20 51.0	00 50		
Do.	do	do		21 24.0	00 10		
Do.	do	do		21 48.5	115 59 50		
Do.	do	do		22 55.0	57 50		
August 12	do	do	12 21 24.0		114 20 25		Sextant No. 1.
Do.	do	do	22 03.8		20 40		Do.
Do.	do	do	22 31.0		21 00		Do.
Do.	do	do	23 28.2		19 10		Sextant No. 2.
Do.	do	do	24 12.3		19 30		Do.
Do.	do	do	25 20.7		19 40		Do.
Do.	do	do		12 26 36.0	19 10		Do.
Do.	do	do		27 19.0	18 50		Do.
Do.	do	do		28 44.5	19 50		Sextant No. 1.
Do.	do	do		29 19.8	19 10?		Do.
Do.	do	do		30 02.0	18 40		Do.
Do.	do	do		30 45.2	18 15		Do.
Do.	do	do		31 41.0	17 20		Do.
August 13	do	do	12 15 31.0		113 32 10		Do.
Do.	do	do	16 06.0		33 10		Do.
Do.	do	do	16 52.4		34 45		Do.
Do.	do	do	17 25.0		35 30		Do.
Do.	do	do	19 06.7		36 20		Sextant No. 2.
Do.	do	do	20 17.7		37 50		Do.
Do.	do	do	21 21.0		39 10		Do.
Do.	do	d	23 06.5		40 50		Do.
Do.	do	do	23 58.3		41 30		Do.
Do.	do	do	24 47.5		42 00		Do.
Do.	do	do	25 50.0		44 30		Sextant No. 1.
Do.	do	do	26 53.2		44 45		Do.

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
August 13	Mission	Sun's lower limb	12 27 31.7		113 45 00		Sextant No. 1.
Do.	do	do		12 28 51.8	43 10		Sextant No. 2.
Do.	do	do		29 51.0	43 00		Do.
Do.	do	do		30 25.0	42 50		Do.
Do.	do	do		31 06.0	42 30		Do.
August 16	do	do	12 23 51.8		111 33 50		Sextant No. 1.
Do.	do	do	24 58.0		36 35		Do.
Do.	do	do	25 34.0		37 50		Do.
Do.	do	do	26 01.3		38 40		Do.
Do.	do	do	26 35.5		39 50		Do.
Do.	do	do	28 41.0		42 00		Sextant No. 2.
Do.	do	do	29 28.2		42 20		Off 32′ 15″.
Do.	do	do	30 02.0		44 00		On 30′ 30″.
Do.	do	do	30 39.4		45 00		Do.
Do.	do	do	31 20.0		45 50		Do.
Do.	do	do	32 37.0		47 20		Do.
Do.	do	do	33 57.5		48 50		Do.
Do.	do	do	34 41.0		49 20		Do.
Do.	do	do	35 24.7		49 50		Do.
Do.	do	do	36 48.0		50 50		Do.
Do.	do	do		12 38 58.0	53 10		Sextant No. 1.
Do.	do	do		40 04.5	53 20		Off 31′ 45″.
Do.	do	do		41 17.8	53 05		On 32′ 05″.
Do.	do	do		42 01.2	52 40		Do.
Do.	do	do		42 55.0	52 20		Do.
Do.	do	do		43 43.0	51 45		Do.
Do.	do	do		44 31.7	51 10		Do.
Aug. 17, a. m.	do	Polaris		4 54 22.8	97 55 40		Sextant No. 2.
Do.	do	do		56 18.8	54 50		Do.
Do.	do	do		5 01 26.0	53 20		Do.
September 6	do	Sun's lower limb	13 32 26.5		96 32 10		Do.
Do.	do	do	33 23.8		35 20		Do.
Do.	do	do	34 11.4		37 40		Do.
Do.	do	do	35 19.0		41 10		Do.
Do.	do	do	35 58.0		43 00		Do.
Do.	do	do	36 40.0		45 00		Do.
Do.	do	do	37 15.7		46 40		Do.
Do.	do	do	42 25.3		97 00 30		Sextant No. 1.

Do.	do	do	43 09.8		02 10		
Do.	do	do	43 50.3		03 25		
Do.	do	do	44 35.9		04 40		Off 31′ 20″.
Do.	do	do	45 18.8		05 40		On 32′ 00″.
Do.	do	do	45 58.5		06 40		
Do.	do	do	46 42.0		07 45		
Do.	do	do	47 24.2		08 40		
Do.	do	do	47 54.2		09 20		
Do.	do	do		14 09 04.8	07 00		
Do.	do	do		09 50.8	06 00		
Do.	do	do		10 31.2	04 50		
Do.	do	do		11 51.4	02 30		
Do.	do	do		12 30.0	00 50		
Do.	do	do		13 39.8	96 57 40		Sextant No. 2.
Do.	do	do		14 20.0	56 10		
Do.	do	do		14 47.0	55 10		Off 32′ 30″.
Do.	do	do		15 16.2	54 10		On 31′ 20″.
Do.	do	do		15 42.3	53 10		
Do.	do	do		16 12.5	52 00		
Sept. 9, p. m.	do	Polaris	21 44 37.0		94 47 40		Sextant No. 1.
Do.	do	do	46 15.2		48 45		
Do.	do	do	47 36.0		49 50		Index error, — 5″.
Do.	do	do	50 14.5		52 10		
Do.	do	do	52 37.0		54 00		
Do.	do	do	53 55.5		55 10		
Do.	do	do	55 17.8		56 20		
Do.	do	do	56 22.3		56 40		
Do.	do	do	57 39.0		57 40		
Do.	do	do	59 06.0		58 30		
Do.	do	do	22 03 31.0		95 00 30		Sextant No. 2.
Do.	do	do	05 32.5		01 40		
Do.	do	do	06 38.0		03 00		
Do.	do	do	08 36.2		04 40		
Do.	do	do	09 53.3		06 00		
Do.	do	do	11 36.0		06 40		
Do.	do	do	12 39.7		07 20		
Do.	do	α Aquilæ	26 07.2		101 35 40		
Do.	do	do	27 36.0		39 00		
Do.	do	do	28 39.0		41 10		
Do.	do	do	29 28.0		42 40		
Do.	do	do	30 39.0		44 40		
Do.	do	do	31 54.5		46 30		
Do.	do	do	34 03.7		50 45		Sextant No. 1.
Do.	do	do	35 38.5		53 00		
Do.	do	do	36 50.0		53 40		
Do.	do	do	38 04.3		54 30		
Do.	do	do		22 51 54.3	49 10		
Do.	do	do		52 56.8	48 20		
Do.	do	do		53 54.5	47 10		
Do.	do	do		54 52.0	45 10?		
Do.	do	do		56 08.0	42 10		
Do.	do	do		57 17.2	40 00		
Do.	do	do		58 32.2	35 20		Sextant No. 2.

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
Sept. 9, p. m.	Mission	α Aquilæ		22 58 32.2	101 35 20		Sextant No. 2.
Do.	do	do		59 45.3	32 20		
Do.	do	do		23 00 50.0	30 30		
Do.	do	do		02 00.5	27 30		
Do.	do	do		03 10.2	24 30		
Do.	do	Polaris	1 19 58.0		97 14 20		Sextant No. 1.
Do.	do	do	22 41.2		16 30		
Do.	do	do	23 32.2		17 00		
Do.	do	do	24 31.0		17 20		
Do.	do	do	25 30.0		18 00		
September 10.	do	Sun's lower limb	13 54 34.0		93 53 50		Sextant No. 2.
Do.	do	do	55 32.8		55 50		Off 32′ 20″.
Do.	do	do	55 57.0		56 40		On 30′ 50″.
Do.	do	do	56 19.8		57 50		
Do.	do	do	56 48.0		58 20		
Do.	do	do	57 08.3		59 00		
Do.	do	do	57 36.6		94 00 00		
Do.	do	do	59 45.5		05 20		Sextant No. 1.
Do.	do	do	14 00 09.3		05 50		Off 31′ 50″.
Do.	do	do	01 22.8		07 50		On 32′ 20″.
Do.	do	do	02 08.7		08 50		
Sept. 12, a. m.	do	Polaris	3 21 31.3		97 56 30		Sextant No. 1.
Do.	do	do	22 23.5		57 00		Do.
Do.	do	do	23 22.0		57 20		Do.
Do.	do	do	24 52.3		57 30		Do.
Do.	do	do	36 41.7		59 00		Do.
Do.	do	do	39 13.0		57 20		Sextant No. 2.
Do.	do	do	41 39.0		59 20		Sextant No. 1.
Do.	do	do	44 46.0		57 30		Sextant No. 2.
Do.	do	do	47 29.5		59 35		Sextant No. 1.
Do.	do	do	53 46.3		58 15		Sextant No. 2.
Do.	do	do	56 19.0		60 00		Sextant No. 1.
Do.	do	do	59 10.8		58 45		Sextant No. 2.
Do.	do	do	4 01 15.5		60 10		Sextant No. 1.
Do.	do	do		4 07 18.5	97 56 42		Sextant No. 2.
Do.	do	do		09 32.0	98 00 10		Sextant No. 1.
Do.	do	do		13 25.0	97 58 35		Sextant No. 2.
Do.	do	do		[illegible] 24.0	57 10		Do.

Do.	do	α Arietis	4 40 10.8		130 01 [illegible]		Sextant No. 1.
Do.	do	do	42 08.0		07 25		Index error, — 5″.
Do.	do	do	43 16.3		10 30		
Do.	do	do	44 39.0		14 00		
Do.	do	do	45 23.3		16 10		
Do.	do	do	46 20.4		17 50		
Do.	do	do	47 51.5		21 50		
Do.	do	do	49 36.0		24 40		
Do.	do	do	55 37.7		26 45		Sextant No. 2.
Do.	do	do	57 24.8		29 20		Index error, + 10″.
Do.	do	do	58 33.5		29 35		
Do.	do	do		5 01 44.2	29 10		Sextant No. 1.
Do.	do	do		03 13.0	27 00		Sextant No. 2.
Do.	do	do		04 21.3	25 30		Do.
Do.	do	do		05 25.0	24 10		Do.
Do.	do	do		09 28.0	16 10		Do.
Do.	do	do		11 07.2	12 30		Do.
Do.	do	do		13 01.5	07 00		Do.
September 23.	Mud Prairie, 4th camp, 9.5 miles from Mission.	Sun's lower limb	12 48 52.2		68 50 00		Sextant No. 1.
Do.	do	do	49 35.6		69 00 00		
Do.	do	do	50 23.3		10 00		
Do.	do	do	51 09.2		20 00		
Do.	do	do	51 58.0		30 00		
Do.	do	do	52 42.2		40 00		
Do.	do	do	53 26.3		50 00		
Do.	do	do	54 16.6		70 00 00		
Do.	do	do	55 03.2		10 00		
Do.	do	do	55 50.0		20 00		
Do.	do	do	56 39.2		30 00		
Do.	do	do		15 09 06.3	84 06 00		Chron. 525.
Do.	do	do		10 09.8	05 40		Sextant No. 1.
Do.	do	do		10 57.3	05 00		Off 31′ 45″.
Do.	do	do		11 30.3	04 00		On 32′ 20″.
Do.	do	do		12 09.2	03 10		
Do.	do	do		13 07.0	01 50		
Do.	do	do		14 54.3	83 58 20		
Do.	do	do		16 01.8	55 40		
Do.	do	do		16 43.2	53 30		
Do.	do	do		17 24.0	52 50		
Do.	do	do		18 33.8	50 30		
Do.	do	do		19 18.8	49 00		
Do.	do	do		20 29.8	46 00		
Do.	do	do		21 06.5	44 10		
Do.	do	do		21 42.3	42 40		
Do.	do	do		22 38.0	40 00		
September 24.	5th camp, 11 miles from Mission	do	13 32 35.8		75 50 00		Off 31′ 50″.
Do.	do	do	33 36.0		76 00 00		On 32′ 10″.
Do.	do	do	34 38.2		10 00		
Do.	do	do	35 40.0		20 00		
Do.	do	do	36 44.3		30 00		
Do.	do	do	37 47.4		40 00		
Do.	do	do	38 53.0		50 00		

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Chronometer time.		Double alt.	Meridian, 2 alt., and time at app. noon	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
September 24.	5th camp, 11 miles from Mission	Sun's lower limb		15 04 32.5	63 26 25		
Do.	do	do		06 08.7	25 30		
Do.	do	do		07 31.3	24 50		
Do.	do	do		08 37.2	24 00		
Do.	do	do		10 04.7	22 50		
Do.	do	do		11 09.4	21 50		
Do.	do	do		12 24.0	20 20		
Do.	6th camp, 13.4 miles from Mission	α Aquilæ		23 30 01.3	99 19 20		
Do.	do	do		31 20.8	11 30		
Do.	do	do		32 46.2	01 10		
Do.	do	do		33 54 5	98 55 00		
Do.	do	do		34 45.5	49 00		
Sept. 24, p. m.	do	Polaris	23 36 36.2		96 09 20		Sextant No. 1.
Do.	do	do	38 54.0		11 40		
Do.	do	do	41 46.0		14 10		
Do.	do	do	45 28.0		16 10		
Do.	do	do	48 09.5		18 30		
Do.	do	do	50 41.8		20 20		
Do.	do	β Aquarii	55 08.2		71 56 00		
Do.	do	do	58 05.8		72 04 20		
Do.	do	do	0 02 11.2		12 00		
Do.	do	do	06 41.8		22 50		
Do.	do	do	08 29.0		25 10		
Do.	do	do	11 07.0		29 10		
Do.	do	do	21 35.0		35 30		
Do.	do	do		0 25 06.0	35 20		
Do.	do	do		26 48.0	35 00		
Do.	do	do		29 12.4	33 20		
Do.	do	do		32 11.5	33 00		
Do.	do	Vega		35 35.3	111 09 30		
Do.	do	do		36 52.5	110 43 10		
Do.	do	do		38 07.4	28 30		
Do.	do	do		39 20.3	109 52 40?		
Do.	do	do		40 40.0	26 30		
Do.	do	do		42 85.3	108 46 50		
Do.	do	do		43 43.2	25 10		
Do.	do	Polaris	0 47 58.3		96 56 00		
Do.	do	do	49 54.0		56 10?		

Do.	do.	do.		51	48.8					[illegible]	[illegible]		
Sept 25, p. m.	do.	Sun's lower limb.	14	00	35.5				79	16	20		
Do.	do.	do.		34	01.4				81	37	20		
Do.	do.	do.		36	39.8					47	30		
Do.	do.	do.		43	25.5				82	11	40		
Do.	do.	do.		45	46.3					16	50		
Do.	do.	do.		46	35.0					19	00		
Do.	do.	do.		47	31.8					21	30		
Do.	do.	do.		48	08.4					22	40		
Do.	do.	do.		51	05.0					28	00		
Do.	do.	do.		52	43.0					31	00		
Do.	do.	do.		53	38.0					33	00		
Do.	do.	do.		55	05.5					34	10		
Do.	do.	do.		56	42.0					35	40		
Do.	do.	do.		57	20.0					36	40		
Do.	do.	do.		59	55.5					38	40		
Do.	do.	do.	15	00	58.5					39	30		
Do.	do.	do.		01	44.0					40	00		
Do.	do.	do.		02	20.5					40	10		
Do.	do.	do.		02	46.0					40	20		
Do.	do.	do.		04	20.5					40	50		
Do.	do.	α Aquilæ	22	22	31.3				101	30	00		
Do.	do.	do.		23	48.3					34	00		
Do.	do.	do.		28	09.8					41	50		Rejected.
Do.	do.	do.		29	45.3					47	10		
Do.	do.	do.		32	07.2					49	40		
Do.	do.	do.		33	15.0					51	50		Rejected.
Do.	do.	do.		35	36.5					53	30		
Do.	do.	do.		37	50.8					54	30		
Do.	do.	do.		38	53.0					55	20		
Do.	do.	do.		40	56.3					56	40		Rejected.
Do.	do.	do.				23	44	39.3		56	00		
Do.	do.	do.					47	07.6		55	30		
Do.	do.	do.					51	44.2		49	40		
Do.	do.	do.					53	51.3		46	50		
September 26.	7th camp, 16.3 miles from mission	Sun's lower limb.				18	07	42.8	54	57	10		
Do.	do.	do.					08	30.2		44	30		
Do.	do.	do.					09	05.0		33	00		
October 1.	8th camp, 20 miles from mission	do.	13	54	43.2	16	59	30.7	70	20			Sextant No. 1.
Do.	do.	do.		55	46.3		58	27.7		30			
Do.	do.	do.		56	49.2		57	24.0		40			
Do.	do.	do.		57	52.8		56	20.0		50			
Do.	do.	do.		58	56.2		55	15.5	71	00			
Do.	do.	do.	14	00	01.0		54	10.7		10			
Do.	do.	do.		01	06.2		53	06.0		20			
Do.	do.	do.				15	26	08.7	78	04	30		
Do.	do.	do.					30	01.3		04	10		
Do.	do.	do.					31	23.4		03	45		
Do.	do.	do.					33	21.3		02	30		
Do.	do.	do.					34	57.3		01	25		
Do.	do.	do.					36	28.2	77	59	30		
Do.	do.	do.					37	50.0		58	10		
Do.	do.	do.					39	18.2		56	00		

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Time by chronometer.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1859.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
October 1	8th camp, 20 miles from mission	Sun's lower limb		15 40 36.0	77 54 20		
Do	do	Polaris	1 53 53.5		97 23 30?		
Do	do	do	55 17.4		25 40		
Do	do	do	58 08.4		26 30		
Do	do	do	2 04 53.0		30 00		
Do	do	do	30 15.3		38 10		
Do	do	do	34 00.0		40 10		
Do	do	do	38 31.7		41 50		
Do	do	do	46 37.8		44 00		
Do	do	α Pegasi		2 22 25.2	112 58 40		
Do	do	do		24 54.0	46 40		
Do	do	do		27 24.7	37 30		
Do	do	α Andromedæ	2 41 49 3		141 05 00		
Do	do	do	44 11.8		21 30?		Limit of scale.
October 2	do	Sun's lower limb		17 31 22.0	64 30	15 30 — 45.5	C.
Do	do	do	13 31 01 0	30 32.0	40		
Do	do	do	31 51.0	29 42.0	50		
Do	do	do	32 40.5	28 51.3	65 00		
Do	do	do	33 31.8	28 00.8	10		
Do	do	do	34 24.4	27 09.8	20		
Do	do	do	35 -14.6	26 17.4	30		
Do	do	do	36 06.5	25 26.0	40		
Do	do	do	37 00.0	24 34.0	50		
Do	do	do	37 52.0	23 41.4	66 00		
Do	do	do	38 46.0	22 50.5	10		
Do	do	do	39 38.0	21 56.5	20		
Do	do	do	40 30.8		30		
Do	do	do	15 22 54.5		77 14 40		
Do	do	do	24 11.0		15 30		
Do	do	do	25 17.4		16 20		
Do	do	do	26 58.8		17 20		
Do	do	do	28 27 0		18 10?		
Do	do	do		15 31 10.8	18 20		
Do	do	do		33 31.8	18 10		
Do	do	do		34 07 0	17 40		
Do	do	do		35 25.5	16 50		
Do	do	do		36 36.0	15 50		
Do	do	do		37 54.5	15 10		
Do	do	do		38 53.5	14 20		

Do.	do	do		40 00.5	42 20		
October 23	Sohon's Pass	do	16 44 53.8		61 43 20		Sextant No. 1.
Do.	do	do			44 00		App. noon.
Do.	do	do		16 54 54.8	41 20		
Do.	do	do		55 54.0	40 20		
Do.	do	do		56 17.5	40 00		
Do.	do	do		17 00 45.3	35 30		
Do.	do	do		01 39.3	34 10		Off 32' 10".
Do.	do	do		02 18.4	33 10		On 32' 20".
Do.	do	do		02 51.0	32 15		
Do.	do	do		03 42 0	31 00		
Do.	do	do		05 01.4	29 00		
Do.	do	do		05 50.3	27 20		
Do.	do	do		06 26.0	26 00		
October 24	do	do	16 29 19.2		60 37 20		Sextant No. 1.
Do.	do	do	29 55.5		38 50		Do.
Do.	do	do	30 35.3		40 20		Do.
Do.	do	do	31 17.2		41 50		Do.
Do.	do	do	31 50.0		42 40		Do.
Do.	do	do	32 40.8		43 00		Sextant No. 2.
Do.	do	do	33 26.5		44 30		Do.
Do.	do	do	34 22.2		46 20		Do.
Do.	do	do	35 05.6		47 20		Do.
Do.	do	do	35 47.4		48 30		Do.
Do.	do	do	36 46.0		51 10		Sextant No. 1.
Do.	do	do	37 12.0?		51 45		Do.
Do.	do	do	38 00.5		52 40		Do.
Do.	do	do	38 44.5		53 35		Do.
Do.	do	do	39 18.3		54 20		Do.
Do.	do	do	40 22.2		54 40		Sextant No. 2.
Do.	do	do	41 02.8		55 20		Do.
Do.	do	do	42 04.2		56 10		Do.
Do.	do	do	43 11 8		57 10		Do.
Do.	do	do	45 12.3		58 50		Do.
Do.	do	do	46 16.0		61 00 50		Sextant No. 1.
Do.	do	do	47 51.0		01 15		Do.
Do.	do	do	48 47.5		01 30		Do.
Do.	do	do	Meridian		02 00		Do.
Oct. 24, p. m.	do	Polaris	23 25 46.8		95 51 35		Do.
Do.	do	do	36 21.0		59 20		Do.
Do.	do	do	40 01.5		96 02 00		Do.
Do.	do	do	42 27.2		04 30		Do.
Do.	do	do	46 03.5		07 20		Do.
Do.	do	do	51 02.7		09 00		Sextant No. 2.
Do.	do	do	54 13.3		10 00		Do.
Do.	do	do	59 41.4		13 50		Do.
Do.	do	do	0 03 11.0		15 10		Do.
Do.	do	do	08 04.5		19 20		Do.
Do.	do	do	10 40.0		21 10		Do.
Do.	do	do	23 57.2		29 20		Do.
Do.	do	do	26 35.5		32 00		Do.
Do.	do	do	29 10.3		33 30		Do.
Do.	do	do	31 02.5		34 10		Do.

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Time by chronometer:		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
1859.							
Oct. 24, p. m.	Sohon's Pass	Polaris	0 33 29.5		96 35 20		Sextant No. 2.
Do.	do	do	36 47.3		36 40		Do.
Do.	do	do	41 10.7		40 30		Sextant No. 1.
Do.	do	do	43 21.0		42 20		Do.
October 26	do	Sun's lower limb	16 48 06.2		50 31 50		Sextant No. 2.
Do.	do	do	49 35.5		31 30		Do.
Do.	do	do	50 46.0		34 30		Do.
Do.	do	do	51 50.3		35 30		Do.
Do.	do	do	53 15.0		36 30		Do.
Do	do	do	53 57.3		37 00		Do.
Do.	do	do	55 09.0		38 30		Sextant No. 1.
Do.	do	do	55 49.5		38 50		Do.
Do.	do	do	56 05.0		39 00		Do.
Do.	do	do	Noon		39 20		Do.
Do.	do	do		17 03 27.8	38 20		Do.
Do.	do	do		04 18.5	38 05		Do.
Do.	do	do		05 14.2	37 30		Do.
Do.	do	do		06 22.5	36 50		Do.
Do.	do	do		08 57.0	34 40		Do.
Do.	do	do		09 50.5	33 50		Do.
Do.	do	do		17 10 59.8	59 31 20		Chronometer 525.
Do.	do	do		12 03.2	30 10		Sextant No. 2.
Do.	do	do		13 18.2	28 30		Off 33′ 10″.
Do.	do	do		14 24.0	26 50		On 31′ 10″.
Do.	do	do		15 15.3	25 20		
1860.							
January 16	Cantonment Jordan	do	4 09 43.8	6 25 36.3	39 30		Chronometer 7961.
Do.	do	do	11 27.5	23 51.5	40		Sextant No. 1.
Do.	do	do	13 10.8	22 06.3	50		
Do.	do	do	15 01.3	20 14.2	40 00		
Do.	do	do	16 48.7	18 20.8	10		
Do.	do	do	18 47.0	16 31.0?	20		
Do.	do	do	20 46.8		30		
Do.	do	do	5 05 50.5		42 45 00		Sextant No. 2.
Do.	do	do	06 07.3		47 20		Off 33′ 20″.
Do.	do	do	09 50.3		48 20		On 31′ 50″.
Do.	do	do	10 32.0		49 00		
Do.	do	do	11 27.5		49 40		
Do.	do	do	14 16.5		51 20		Sextant No. 1.

Do.	do	do	18 08.3		51 40		Off 32' 40''.
Do.	do	do		5 18 57.9	51 30		On 32' 30''.
Do.	do	do		20 40.3	51 10		
Do.	do	do	5 13 34.3	22 11.5	50 40		Sextant No. 1.
January 27	do	do	15 21.6		47 45 00		Off 32' 40''.
Do.	do	do	17 09.3		45 40		On 32' 30''.
Do.	do	do	19 23.7		46 50		
Do.	do	do	21 29.2		47 20		
Do.	do	do			47 50		
Do.	do	do		5 23 15.3	48 00		
Do.	do	do		25 40.5	47 00		
Do.	do	do		28 24.8	45 40		
Do.	do	do		29 44.3	44 50		
Do.	do	do		31 19.8	43 50		Chronometer 7961.
Do.	do	do	4 06 00.5	6 37 18.7	43 30		Sextant No. 1, through tree.
Do.	do	do	07 30.7	35 46.2	40		
Do.	do	do	09 01.8	34 14.0	50		
Do.	do	do	10 36.0	32 39.5	44 00		
Do.	do	do	12 11.0	31 02.5	10		Through clouds.
Do.	do	do	13 51.8	29 25.5	20		
Do.	do	do	15 29.8	27 46.3	30		
Do.	do	do	17 11.0?	26 03.7	40		
Do.	do	do	19 . . .	24 21.9	50		
Do.	do	do	21 34.0?	22 29 0	45 00		
Do.	do	do	22 36.0	20 37.7	10		
Do.	do	do	24 30.0	18 46.3	20		
Do.	do	do	26 27.9	17 44.0	30		
March 10	Bitter Root Observatory	do	2 04 10.4		76 38 40		Chronometer 525.
Do.	do	do	05 03.5		39 15		Sextant No. 1.
Do.	do	do	06 24.0		43 20		Off 32' 00''.
Do.	do	do	07 18.0		46 00		On 32' 10''.
Do.	do	do	08 09.7		48 20		
Do.	do	do	09 59 5		53 10		
Do.	do	do	10 38.3		54 40		
Do.	do	do	11 22.8		56 30		
Do.	do	do	12 20.4		58 20		
Do.	do	do	13 16.5		77 00 40		
Do.	do	do	15 27.2		04 50		
Do.	do	do	16 26.8		06 30		
Do.	do	do	17 10.0		07 45		
Do.	do	do	18 19.3		09 40		
Do.	do	do	19 13.8		11 10		
Do.	do	do	22 58.0		15 30		
Do.	do	do	23 51.9		16 20		
Do.	do	do	24 30 3		17 10		
Do.	do	do	25 19.6		17 45		
Do.	do	do	26 10.3		18 05		
Do.	do	do	Meridian		20 15		
Do.	do	do		2 37 37.5	18 00		
Do.	do	do		38 27.7	17 30		
Do.	do	do		39 27.3	16 50		
Do.	do	do		40 24.0	15 50		
Do.	do	do		41 09.8	15 15		

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Object.	Time by chronometer.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
1860.			h. m. s.	h. m. s.	° ′ ″	h. m. s.	
March 10	Bitter Root Observatory	Sun's lower limb		2 43 42.2	77 12 25		
Do	do	do		44 36.2	11 00		
Do	do	do		45 33.3	09 30		
Do	do	do		46 30.0	08 10		
Do	do	do		47 03.2	07 20		
Do	do	do		52 45.2	76 52 40		
Do	do	do		53 29.5	54 00		
Do	do	do		54 12.8	52 20		
March 12	do	do	2 18 39.8		78 30 00		
Do	do	do	20 00.3		33 00		
Do	do	do	20 53.5		35 00		
Do	do	do	21 44.4		37 00		
Do	do	do	22 44.7		39 00		
Do	do	do	23 51.2		41 00		
Do	do	do	24 31.2		42 00		
Do	do	do	25 04.7		43 00		
Do	do	do	25 30.4		44 00		
Do	do	do	26 15.0		45 00		
Do	do	do	27 06.2		46 00		
Do	do	do	27 48.2		47 00		
Do	do	do	28 29.5		48 00		
Do	do	do	29 33.3		49 00		
Do	do	do	30 15.2		50 00		
Do	do	do	31 09.2		51 00		
Do	do	do	32 19.2		52 00		
Do	do	do	Meridian		55 10		
Do	do	do		2 46 53.5	52 00		Sextant No. 1.
Do	do	do		47 56.3	51 00		Off 32° 10′.
Do	do	do		49 03.8	50 00		On 32° 20′.
Do	do	do		49 51.5	49 00		
Do	do	do		50 49.5	48 00		
Do	do	do		51 32.7	47 00		
Do	do	do		52 15.2	46 00		
Do	do	do		52 55.0	45 00		
Do	do	do		53 26.5	44 00		
Do	do	do		54 06.9	43 00		
Do	do	do		54 46.8	42 00		
Do	do	do		55 17.0	41 00		
Do	do	do		56 00.5	39 00		

Do	do	do		57 23.5	37 00		
Do	do	do		58 20.0	35 00		
Do	do	do		59 06.0	33 00		
Do	do	do		3 00 32.7	30 00		
March 13	do	do	2 24 29.3		79 21 20		
Do	do	do	25 14.6		23 00		
Do	do	do	25 55.2		24 10		
Do	do	do	27 02.0		26 30		
Do	do	do	27 44.0		28 30		
Do	do	do	28 30.4		29 00?		
Do	do	do	29 17.8		30 30		
Do	do	do	30 10.4		31 40		
Do	do	do	33 10.0		35 40		
Do	do	do	34 02.2		36 50		
Do	do	do	35 08.2		37 40		
Do	do	do	36 06.5		38 40		
Do	do	do	36 53.0		39 30		
Do	do	do	Meridian		41 45		Sextant No. 1.
Do	do	do		2 47 30.2	40 40		Off 32 10''. | 32' 15'
Do	do	do		48 35.8	40 10		On 32' 20''. | 32' 15''
Do	do	do		49 59.8	39 15		
Do	do	do		51 37.0	37 30		
Do	do	do		53 05.2	36 25		
Do	do	do		55 09.7	33 45		
Do	do	do		56 34.2	32 00		
Do	do	do		57 57.4	30 00		
Do	do	do		59 55.2	26 00		
Do	do	do		3 00 58.5	24 10		
March 14	do	do	2 25 18.3		80 01 30		
Do	do	do	25 58.0		03 10		
Do	do	do	26 44.7		05 00		
Do	do	do	27 28.2		06 45		
Do	do	do	28 17.5		08 30		
Do	do	do	29 13.8		10 40		
Do	do	do	33 37.3		18 40		
Do	do	do	34 30.8		19 40		
Do	do	do	35 22.8		21 10		
Do	do	do	36 19.2		22 25		
Do	do	do	37 13.0		23 40		
Do	do	do	38 04.3		24 20		
Do	do	do	40 27.2		26 45		
Do	do	do	41 44.5		27 40		
Do	do	do	43 22.8		28 30		
Do	do	do	44 45.2		29 00		
Do	do	do	Meridian		29 10?		
Do	do	do		2 49 30.2	28 40		
Do	do	do		51 46.3	27 50		
Do	do	do		53 30.3	26 40		
Do	do	do		54 49.5	25 45		
Do	do	do		56 31.9	24 10		
Do	do	do		59 35.0	20 45		
Do	do	do		3 00 19.8	19 20		Off 32' 10''.
Do	do	do		00 54.0	18 00		On 32' 20''.

Sextant observations—Continued.

MILITARY ROAD.

Date.	Station.	Object.	Time by chronometer.		Double alt.	Meridian, 2 alt., and time at app. noon.	Remarks.
			Before culm.	After culm.			
			h. m. s.	h. m. s.	° ′ ″	° ′ ″	
1860.							
March 14	Bitter Root Observatory	Sun's lower limb		3 01 37.7	80 17 05		
Do	do	do		02 27.7	15 50		
Do	do	do		03 54.3	13 10		
Do	do	do		06 08.3	08 40		
Do	do	do		06 52.5	06 50		
Do	do	do		07 37.5	05 05		
Do	do	do		08 23.7	03 10		
March 19	do	do	2 53 42.2		34 17 10		
Do	do	do	54 48.0		18 40		
Do	do	do	56 06.2		19 40		
Do	do	do	57 18.7		21 40		
Do	do	do	58 30.2		22 30		
Do	do	do	59 35.0		23 20		
Do	do	do	3 01 05.3		24 20		
Do	do	do	02 43.8		25 20		
Do	do	do	Meridian		26 15		
Do	do	do		3 10 02.8	25 00		
Do	do	do		11 25.3	24 10		
Do	do	do		12 32.0	22 30		
Do	do	do		15 04.2	21 20		

VOLUME C.

TRANSIT OBSERVATIONS.

NEW FORT WALLA-WALLA.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
May 25	Polaris . .... W.	......	3	16 15 16.50
	Polaris. .... E.	.....	2	21 26.50
	Levelled:			
	β Libræ. ..... W.	+ 19	9	18 12 31.60
	α Cor. Bor .... W.	......	7	31 39.21
	α Serpentis ... W.	+ 34	7	40 21.09
	β¹ Scorpii . .... W.	27	9	19 00 23.18
	α Scorpii . .... W.	+ 24	9	23 56.93
	ε Scorpii . .... W.	......	8	44
	1 .... W.	+ 14	6	50
	ν Scorpii . .... W.	+ 20	8	20 24
	λ Scorpii . .... W.	......	8	27
	Vega . ... W.	+ 3	9	21 35 02.59
26	Polaris . ... W.	13	5	16 16 49.60
	Arcturus . .. W.	11	5	17 12 12.10
	α² Libræ. ...... W.	13	9	46 13.22
	β Urs. Min ... W.	6	3	53 33.10
	β Libræ .. .... W.	+ 10	8	18 12 31.80
	γ Urs. Min.... W.	......	8	23 27.60
	α Cor. Bor... W.	+ 3	7	31 39.90
	α Serpentis ... W.	9	9	40 21.50
	β¹ Scorpii ..... W.	+ 9	9	19 00 24.20
	α Scorpii ..... W.	......	8	23 58.00
27	Polaris...... W.	+ 31	5	16 17 42.50
	Arcturus . .. W.	......	9	17 12 12.14
	5 Urs. Min.... W.	......	2	30 06.40
	α² Libræ .. .... W	+ 35	9	46 13.49
	T.Y.C. * 1191. W.	......	2	46 01.90
	β Urs. Min.... W.	+ 13	6	53
	β Libræ .. .... W.	+ 19	9	18 12 31.98
	γ Urs. Min.... W.	......	8	18 23 24.20
	T.Y.C. * 1247. W.	......	4	19
	α Cor. Bor.... W.	......	9	31 39.37
	α Serpentis ... W	+ 20	9	40 21.56
	β¹ Scorpii ..... W.	19	9	19 00 24.53
	α Scorpii ..... W.	22	9	23 58.50
	T. Y. C. * 402. W.	+ 24	2	....
	2 .... W.	.... .	8	....
	α Ophiuchi ... W.	+ 24	9	20 31 23.66
	22 Hev.... .... W.	− 2	9	21 06 44.91
	51 Hev.... .... W.	......	1	....
	Vega ... . W.	+ 13	7	35 07.50
28	Polaris...... W.	9	6	16 18 08.80
	α Virginis..... W.	+ 13	9	20 53.80
	α Draconis . .. W.	......	1	17 03
	Arcturus . .. W.	......	6	12 12.65
	5 Urs. Min.... W.	+ 16	7	30 04.90
	ε Bootis ...... W.	......	7	41
	α² Libræ........ W.	+22.0	9	46 14.79
	T.Y.C. * 1191. W.	......	8	46 03.39
	β Urs. Min.... W.	......	5	53
	β Libræ .. .... W.	......	3	18 12 33.30
	γ Urs. Min.... W.	......	4	....
	α Cor. Bor.... W.	......	9	31 39.70
	α Serpentis ... W.	+ 16	9	40 22.34
	ζ Urs. Min.... W.	15	6	51 14.42
	β¹ Scorpii ..... W.	16	8	19 00 26.01
	δ Ophiuchi.... W.	17	5	10 03.72
	α Scorpii ..... W.	12	8	24 00.22
May 29	Polaris...... W.	27	3	16 19 02.20
	3 .... W.	27	8	17 01
	4 .... W.	+ 25	9	17 15 19 30
	β Urs. Min .... W.	......	1	....
30	Polaris . .... W.	+ 22	5	16 19 32.00
	12 Can. Ven. .. W.	27	8	15 52
	α Virginis .. .. W.	+ 24	9	16 20 54.80
1859. May 30	η Urs. Maj.... W.	......	9	16 44 45.10
	5 Centauri . .. W.	+ 23	8	17 01
	Arcturus.... W.	24	9	12 12.21
	5 Urs. Min.... W.	. 24	7	29 58.21
	α² Libræ .. .... W.	+ 30	9	46 15.79
	T.Y.C. * 1191. W.	......	9	46 04.32
	β Urs. Min.... W.	+ 23	7	53 21.44
	T. Y. C. * 273. W.	+ 26	9	18 10 11.60
	γ Urs. Min.... W.	......	6	23
	T.Y.C. * 1247. W.	......	1	....
	α Cor. Bor.... W.	+ 28	9	32 29.61
	ζ Urs. Min .. W.	23	4	51
	B.A.C. * 5638. W.	+ 25	9	19 45 41.59
	B.A.C. * 5640. W.	......	8	45
	Capella ..... W.	+ 24	9	20 09 28.76
31	α Cassiopeæ .. W.	......	8	15 35
	12 Can. Ven. .. W.	......	4	52
	Polaris . .... W.	+ 5	7	16 19 10 30
	α Virginis. .... W.	+ 8	6	20 54.52
	α Draconis.... W.	......	8	17 03
	Arcturus . .. W.	......	4	12 12.40
	5 Urs. Min .. W.	+ 7	9	29 59.51
	T.Y.C. * 1191. W.	......	9	46 03.91
	α² Libræ .. .... W.	+ 11	9	17 46 15.29
	β Urs. Min.... W.	5	7	53
	β Libræ .. .... W.	+ 4	9	18 12 33.45
	Cor. Bor.... W.	......	7	31 39.56
	α Serpentis ... W.	+ 2	9	40 22.67
	β¹ Scorpii. .... W.	− 2	9	19 00 26.43
	ε Urs. Min.... W.	1	6	01 57.50
	Capella .. . W.	1	9	20 09 27.88
	λ Urs. Min.... W.	3	2	22 55 33
	α Ophiuchi ... W.	− 2	9	20 31 24.52
	γ Draconis . .. W.	......	9	56 03.70
	δ Urs. Min.... W.	− 8	4	21 17 03.90
	Vega . ... W.	− 2	9	35 01.90
June 1	β Corvi .. .... W.	+ 4	9	15 30 11.58
	α Cassiopeæ .. W.	− 11	8	35
	12 Can. Ven. .. W.	......	9	52 16.67
	Polaris...... W.	− 4	5	16 19 27.40
	α Virginis..... W.	+ 4	9	20 54.24
	η Urs. Maj .... W.	......	9	44 44.60
	η Bootis ...... W.	+ 4	9	50 57.04
	5 .... W.	......	4	17 12
	Arcturus . .. W.	+ 1	9	12 12.59
	α Draconis.... W.	......	8	03
	5 Urs. Min.... W.	− 2	9	29 50.52
	6 .... W.	......	2	41
	7 .... W.	......	9	50 59.72
2	Polaris . .... W.	+ 3	7	16 18 56
	β Urs. Min.... W.	.....	9	17 53 31.50
	γ Urs. Min... W.	......	8	18 23 28.20
	α Serpentis ... W.	... ..	4	40 25.40
	β¹ Scorpii . .... W.	.....	8	19 00 27.40
	α Scorpii . .... W.	− 20	9	19 24 02.00
	ε Urs. Min. ... W.	− 20	3	20 02 12.90
4	β Corvi . ..... W.	+ 10	9	15 30 12 67
	γ Virginis. ... W.	8	9	37 36.72
	δ Virginis. .... W.	11	9	51 34.18
	θ Virginis. .... W.	12	6	16 05
	Polaris...... W.	6	9	19 37.80
	α Virginis. .... W.	14	5	20
	ζ Virginis. .... W.	13	9	30 36.05
	80 Virginis. .... W.	+ 13	9	45 24.56
	94 Virginis. .... W.	.....	9	17 00 02.04
	Arcturus.... W.	+ 2	9	12 12.80

Transit observations—Continued.

NEW FORT WALLA-WALLA.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
June 4	5 Urs. Min ... W.	+ 3	6	17 29 58.35
	β Urs. Min.... W.	+ 2	8	53
	Capella ..... W.	− 6	9	20 09 29.10
5	Moon's I L.. W.	+ 15	9	12 29 18.89
	δ Virginis .... W.	20	6	15 51 34.18
	θ Virginis ..... W.	16	6	16 05 46 27
	Polaris ...... W.	14	5	19 53.60
	α Virginis ..... W.	+ 4	9	20 54.97
	η Urs. Maj. ... W.	......	9	44 44.69
	η Bootis ...... W.	+ 11	9	50 57 51
	Arcturus .... W.	+ 10	9	17 12 13.26
	5 .... W.	......	....	12
	ε Bootis .... W.	+ 13	9	41 46.43
	α Serpentis.... W.	10	9	8 40 23 23
	β¹ Scorpii ...... W.	10	9	19 00 27.64
	α Scorpii ...... W.	+ 7	9	24 02.22
6	Sun's I L.... W.	− 39	9	58 53.58
	Sun's II L... W.	− 33	8	78 01
	Moon's I L.. W.	+ 26	9	13 24 15.84
	γ Virginis..... W.	32	1	15 37
	δ Virginis..... W.	23	7	51 35.12
	θ Virginis. .... W.	30	5	16 05 47.26
	Polaris ..... W.	21	7	20 22.90
	β Corvi....... W.	24	9	15 30 13.72
	α Virginis..... W.	22	4	16 20 56.17
	ζ Virginis.. .. W.	24	9	30 37.07
	η Urs. Maj..... W.	20	9	44 45.31
	η Bootis .. ... W.	+ 18	8	50 58.28
	5 .... W.	......	..	17 12 00.00
	Arcturus .... W.	+ 15	9	12 13.60
	ε Bootis ...... W.	15	9	41 46.93
	β Urs. Min ... W.	11	5	53 19.64
	α Persei....... W.	15	9	18 17 32.24
	α Serpentis ... W.	14	9	40 24.30
7	Moon's I L.. W.	43	9	14 16 05.27
	γ Virginis ..... W.	36	6	15 37 37.23
	δ Virginis ..... W.	35	9	51 34.68
	θ Virginis..... W	28	6	16 05 47.00
	Polaris....... W.	27	9	19 07.30
	α Virginis .... W.	19	5	20 56.02
	ζ Virginis..... W.	17	9	30 36.98
	m Virginis. .... W.	13	3	37 22.30
	86 Virginis..... W.	+ 16	6	41
	5 .... W.	......	7	17 12
	Arcturus.... W.	+ 13	9	12 13.76
	5 Urs. Min.... W.	15	8	29 58 01
	ε Bootis ...... W.	14	9	41 47 31
	β Urs. Min.... W.	11	9	53 21.09
	α Persei ...... W.	10	9	18 17 32.01
	α Serpentis.... W.	7	9	40 24.43
8	Moon's I L.. W.	17	9	15 06 16.07
	β Corvi .... W.	16	6	30 13 77
	γ Virginis..... W.	16	9	37 37.91
	12 Can. Ven.... W.	10	9	52 18.52
	θ Virginis..... W	11	6	16 05 47.28
	Polaris ..... W.	11	9	19 56.30
	α Virginis..... W.	9	5	20 56.32
	ζ Virginis..... W.	10	9	30 37.21
	m Virginis..... W.	13	7	37 22.44
	η Urs. Maj... W.	12	8	44 46.11
	95 Virginis..... W.	16	7	17 02
	Arcturus..... W.	11	9	12 14.06
	μ Virginis..... W.	9	9	38 46.64
	β Urs. Min.... W.	+ 10	7	53 20.69
	β Libræ......... W.	....	9	12 12 35.60
	α Persei. ...... W.	+ 6	7	17 31.96
	ζ Urs. Min .... W.	7	9	51 07.69
	δ Ophiuchii.... W.	8	9	19 10 06.08
	α Scorpii ...... W.	8	9	24 03.53
	Capella ..... W.	4	9	20 09 30.38
10	Sun's I L.... W.	+ 6	2	8 15

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
June 10	Sun's II L... W.	− 4	6	8 17
	12 Can. Ven.... W.	+ 42	3	15 52 18.99
	θ Virginis..... W	....	4	16 05 46.70
	Polaris .... W.	+ 42	1	19
	α Virginis... . W.	43	8	20 55.72
	ζ Virginis. ... W.	+ 39	9	30 36.83
	m Virginis..... W.	......	9	37 21.66
	86 Virginis..... W.	......	5	41 35.66
	Moon's I L.. W.	+ 41	9	46 57 07
	94 Virginis..... W.	......	9	17 01 58.96
	κ Virginis..... W.	......	7	08 32.28
	λ Virginis..... W.	+ 46	9	14 39.63
	μ Virginis..... W.	+ 38	6	38 45.66
	5 Libræ .... W.	......	5	41 23.04
	μ Libræ .... W.	......	9	44 46.82
	T.Y.C(*1191) W.	......	2	46 04.50
	α² Libræ........ W.	......	3	46 16.77
	ξ² Libræ....... W.	......	9	52 17.36
	20 Libræ....... W.	......	9	59 05.07
	ι Libræ........ W.	+ 44	9	18 07 24.70
	β Libræ....... W.	......	9	12 34 82
	α Persei....... W.	......	6	17 31.06
	ξ¹ Libræ........ W.	+ 46	9	23 30.66
	γ Libræ........ W.	......	9	30 50.14
	κ Libræ.. ..... W.	......	9	37 03.04
	η Libræ........ W.	......	4	39 20.76
	T.Y.C.*1290. W.	......	7	45
	δ Scorpii ...... W.	......	9	55 14.70
	β¹ Scorpii ...... W.	+ 38	9	19 00 28.90
	σ Scorpii ...... W.	42	9	15 53 60
	η Draconis .... W.	41	9	24 42.57
	ε Urs. Min.... W.	37	9	20 01 54.92
	β Draconis.... W.	41	3	29 59.30
11	β Corvi .... W.	80	4	15 30 13.78
	γ Virginis. ... W.	75	9	37 37.68
	12 Can. Ven.... W.	64	8	52 18.34
	θ Virginis..... W.	50	6	16 05 47.58
	Polaris...... W.	68	4	20 19
	α Virginis..... W	60	9	20 56.61
	ζ Virginis. .. W.	55	9	30 37.50
	m Virginis..... W.	49	9	37 22.45
	89 Virginis..... W.	+ 59	9	45 25.90
	94 Virginis..... W.	......	9	17 01 59.68
	κ Virginis..... W.	....	9	08 32.83
	λ Virginis. .... W.	+ 62	9	14 40.30
	5 Urs. Min ... W.	58	6	29 57.17
	Moon's I L.. W.	+ 60	9	30 31 84
	T.Y.C.*1191 W.	......	9	46 06.07
	α² Libræ....... W.	+ 59	9	46 17.61
	20 Libræ. ...... W.	......	9	59 05 94
	ι¹ Libræ........ W.	+ 58	9	18 07 25.74
	α Persei . ... W.	55	9	17 32.92
	κ Libræ........ W.	54	9	37 04.00
	ζ Scorpii ...... W.	+ 50	5	51 29 70
	δ Scorpii ...... W.	......	4	55 16.78
	β¹ Scorpii...... W.	......	9	19 01 29.18
	σ Scorpii....... W.	+ 51	9	15 54.67
	η Draconis .... W.	+ 47	9	24 42.76
	24 Scorpii ...... W.	......	5	36 39.44
	ε Urs. Min ... W.	+ 46	5	20 01 53.99
	ζ Ophiuchi.... W.	......	9	05 31.11
	Λ Ophiuchi.... W.	......	7	09 50.09
	η Ophiuchi.... W.	+ 46	9	15 49.06
	β Draconis.... W.	43	9	29 59.97
12	12 Can. Ven... W.	46	3	15 52 19.90
	Polaris ..... W.	43	5	16 20 15
	α Virginis..... W.	+ 39	1	20 58
	ζ Virginis. .. W.	....	9	30 38.99
	m Virginis. .... W.	.....	2	37 24.40
	94 Virginis..... W.	......	9	17 02 01.19
	κ Virginis..... W.	......	2	08 34.90

Transit observations—Continued.

NEW FORT WALLA-WALLA.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
June 12	Arcturus .... W.	+ 41	3	17 12 15.83
	β Urs. Min .... W.	......	3	53 22.40
	20 Libræ ...... W.	+ 50	2	59 07.65
	β Libræ. ...... W	+ 41	4	18 12 37.60
	ξ¹ Libræ. ...... W.	......	4	23 33.70
	Moon's I L.. W.	+ 50	9	34 15.59
	κ Libræ .... W	+ 39	5	37 06.04
	λ Libræ .... W.	.....	9	48 25.70
	ρ Scorpii ...... W.	......	6	51 31.68
	δ Scorpii ...... W.	......	7	55 17.64
	β¹ Scorpii ...... W	+ 39	9	19 00 30.96
13	12 Can. Ven ... W.	+ 49	6	15 52 20.98
	θ Virginis ..... W.	.....	1	16 05 50.9
	Polaris ...... W.	+ 45	6	20 42.0
	α Virginis ..... W.	44	4	20 59.97
	ζ Virginis ..... W.	43	9	30 40.80
	η Urs. Maj .... W.	45	9	44 48.56
	Arcturus ... W.	40	9	17 12 17.30
	T.Y.C.* 1191.W.	+ 47	9	46 09.90
	α² Libræ .... W.	......	9	46 21.30
	20 Libræ ...... W.	+ 44	9	59 09.66
	ι¹ Libræ .... W.	......	9	18 07 29.46
	α Persei .... .W.	+ 49	9	17 36.84
	α Cor. Bor .... W.	46	9	31 44.21
	κ Libræ .... W.	46	7	37 07.61
	ρ Scorpii ...... W.	58	9	51 33.69
	δ Scorpii ...... W.	+ 48	8	55 19.64
	σ Scorpii ...... W.	......	7	19 15 58.20
	α Scorpii ...... W.	+ 54	....	24 07.21
	Moon's I L. W.	+ 54	9	30 48.58
	τ Scorpii ...... W.	... ..	6	30 29.27
	24 Scorpii ...... W.	+ 52	9	36 43.07
	20 Ophiuchi .... W.	47	5	45
	η Ophiuchi .... W	+ 47	9	20 05 34.56
	A Ophiuchi .... W.	.....	9	10 02.69
	ξ Ophiuchi ... W.	......	5	20 15
	θ Ophiuchi .... W.	.....	3	16
	b Ophiuchi .... W	......	7	21
	c² Ophiuchi .... W.	......	9	26 09.71
	β Draconis .... W.	+ 42	2	30 02.4
	γ Draconis .... W.	......	9	56 07.93
	γ Sagittarii ... W.	......	6	21 00 09.30
	δ Urs. Min .... W.	+ 39	3	16
	Vega ...... W.	38	9	35 05.97
14	B.A.C.*4958. W.	42	1	17 58
	Moon's I L.. W.	+ 45	4	20 28 00.5
	Moon's II L. W.	......	1	....
15	Moon's II L. W.	+ 9	4	21 27 17.55
16	Polaris ...... W.	33	2	16 21 12.0
	Arcturus .... W.	32	9	17 12 21.82
	5 Urs. Min .... W.	+ 28	5	29 58.94
	T.Y.C.*1191. W.	......	9	46 14.62
	α² Libræ .. . W.	......	9	46 26.19
	β Urs. Min .... W.	+ 30	7	53 23.61
	α Persei ...... W.	36	8	18 17 42.46
	α Cor. Bor .... W.	31	9	31 48.37
	ρ Scorpii ..... W.	30	9	51 38.48
	ν Herculis ... W.	34	9	19 01 20.22
	σ Scorpii ..... W.	+ 36	9	16 03.23
	α Scorpii ..... W.	......	9	24 12.08
	τ Scorpii ..... W.	+ 37	9	30 33.92
	Capella ..... W.	29	9	20 09 40.24
	α Ophiuchi .... W.	22	8	31 34.43
	γ Sagittarii ... W.	26	9	21 00 13.99
	δ Urs. Min .... W.	+ 25	2	16

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
June 16	λ Sagittarii ... W.	+ 26	8	21 22
	Vega .... W.	+ 22	9	35 00.90
	29 Sagittarii .. W.	......	4	44
	ν¹ Sagittarii ... W.	.....	5	49
	σ Sagittarii ... W.	......	5	49
	ζ Sagittarii ... W.	......	9	57 07.02
	τ Sagittarii ... W.	+ 24	9	22 01 35.67
	Moon's II L. W	24	9	22 03.27
	h² Sagittarii ... W.	25	9	31 33.79
	λ Urs. Min .... W	+ 26	1	54 29
	Piazzi XIX 366.	... ..	9	58 52.96
	π Capricorni .. W	+ 23	9	23 22 37.63
17	Polaris ...... W.	56	1	16 21 07
	ε Bootis ...... W.	55	9	17 41 55.09
	β Urs. Min .... W.	53	9	53 24.36
	β Libræ .... W.	60	9	18 12 44 08
	α Persei ...... W.	60	9	17 42.33
	α Cor. Bor .... W.	56	9	31 48.89
	α Serpentis .... W.	58	9	40 32.74
	ρ Scorpii .... W.	58	9	51 38.97
	9 Sagittarii ... W.	49	4	20 58
	μ¹ Sagittarii ... W.	44	9	21 08 44.37
	δ Urs. Min .... W.	+ 45	2	16
	Bradley 2333 ...	.....	8	33
	φ Sagittarii ... W.	.....	3	43
	ν¹ Sagittarii ... W.	+ 44	7	49
	χ¹ Sagittarii ... W.	44	9	22 20
	f Sagittarii ... W.	44	9	41 31.64
	λ Urs. Min .... W.	43	3	54
	Piazzi XIX 366.	50	7	58 52.81
	Moon's II L. W.	49	9	23 14 02.07
	ν Capricorni .. W.	48	9	35 24.10
	α Cygni .... W.	52	7	39
	ω Capricorni .. W.	+ 57	9	46 50.93
	61¹ Cygni .... W.	......	9	24 03 35.21
	ι Capricorni .. W.	+ 45	9	17 45.66
	ζ Capricorni .. W.	49	8	22 01.51
	ε Capricorni . W.	43	9	32 34.34
18	δ Urs. Min .... W.	69	6	21 17
	β Lyræ .... W	73	9	47 55.77
	f Sagittarii ... W	74	9	22 41 30.92
	λ Urs. Min .... W.	69	9	55 15.6
	Piazzi XIX 366.	70	8	58 51.28
	π Capricorni .. W.	+ 69	9	23 22 36.99
	ρ Capricorni .. W.	......	2	24 11.00
	α Cygni .... W.	+ 68	8	39
	Moon's II L. W.	+ 67	9	24 03 05.27
	ι Capricorni .. W.	.....	3	17
	θ Urs. Maj .... W.	.....	9	26 51.51
	ε Capricorni .. W.	.....	9	32 33.50
	γ Capricorni .. W	.....	5	35 00.00
	δ Capricorni .. W.	+ 66	9	42 36.67
19	Polaris ...... W.	115	1	16 20 18.6
	Polaris ...... W.	157	9	38.0
	Polaris ...... E..	157	2	27 09.5
	β Urs. Min .... W	153	5	17 53 27.0
	β Urs. Min .. E.	+157	1	52 52.6
	γ Urs. Min .... E	.....	5	18 22 53.6
	γ Urs. Min .... W.	+143	3	21.8
	η Draconis .... W.	+147	1	19 25 50.1
	η Draconis .... W.	−151	2	59.7
	ε Urs. Min .... W	−138	2	20 02 26.9
	ε Urs. Min .... W.	+ 91	2	04.3
	ε Urs. Min .... W.	− 93	2	21.4
	ε Urs. Min .... W.	+ 2	2	12.8

Transit observations—Continued.

CŒUR D'ALÊNE MISSION.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
Aug. 4	Moon's I L...W.	− 30	9	16 59 29.16
	β Lyræ ....W.	29	9	21 42 13.08
	τ Sagittarii ...W.	23	7	56 24.27
	λ Urs Min....W.	− 29	3	22 26 34.5
	e² Sagittarii ...W.	....	9	32 31.92
	f Sagittarii ...W.	− 30	6	36 16.45
	α¹ Capricorni ..W.	....	1	23 07 51.7
	α² Capricorni ..W.	....	8	08 15.46
	π Capricorni ..W.	− 33	9	17 21.86
	α Cygni........W.	26	9	33 43.87
5	Moon's I L..W.	− 1	7	17 53 31.86
	α Lyræ ....W.	+ 17	4	21 29 11.9
	ζ Aquilæ ......W.	+ 25	6	55 57.73
7	α Scorpii . ...W.	− 62	9	19 17 50.51
	Moon's I L...W.	63	9	44 52.81
	ε Urs. Min....W.	− 58	2	58 11.7
	η Ophiuchi....W.	....	3	59 23.17
	b Ophiuchi....W.	... .	1	20 16 33.2
	c² Ophiuchi....W	....	9	19 54.39
	γ Draconis....W.	− 54	9	50 26.26
	o Serpentis ...W.	....	7	30
	d Sagittarii ...W.	....	9	21 09 04.40
	λ Sagittarii ...W.	− 46	9	16 22.44
	Vega ....W.	47	4	29 16.37
	ξ Sagittarii ...W.	− 46	9	50 44.76
	τ Sagittarii ...W.	....	6	55 14.63
	α Aquilæ ......W.	− 45	8	22 40 59.81
	c Sagittarii ...W.	47	9	51 05.63
	λ Urs. Min ....W.	45	1	23 06 17 3
8	Sun's I L. ...W.	− 72	7	12 08 30.40
	Sun's II L.. W.	76	9	10 42.50
	α Scorpii ......W.	60	9	19 17 53.00
	τ Scorpii ......W.	60	9	24 13.50
	ε Urs Min....W.	− 56	9	58 13.04
	b Ophiuchi.. ..W.	....	9	20 14 53.40
	β Draconis....W	− 52	9	24 24.29
	Moon's I L...W.	− 48	9	41 42.01
	γ Sagittarii ....W.	....	9	53 53.38
	δ Sagittarii.. ..W.	....	1	21 09
	δ Urs. Min....W.	− 45	2	16 16.9
	λ Sagittarii.. ..W.	....	9	16 24.43
	51 Hev. Cephei.W.	.....	2	28
	Vega.. .. ...W.	− 43	9	29 18.23
	σ Sagittarii....W.	− 43	4	43
	ζ Sagittarii ...W.	....	9	50 47.13
	τ Sagittarii ...W.	− 42	9	55 16.86
	λ Urs Min....W	39	3	23 06 05.4
	T.Y.C.* 753..W.	36	9	15 22 54
9	Sun's I L....W.	85	9	12 12 21.21
	Sun's II L....W.	− 80	8	14 33.10
	α Scorpii ......W.	....	9	19 17 54.51
	τ Scorpii .....W.	− 62	9	24 15 24
	ε Scorpii......W.	.....	9	38 11.19
	ε Urs. Min....W.	− 62	9	58 16.04
	θ Ophiuchi ... W.	.....	4	20 10
	b Ophiuchi....W.	....	9	14 54.76
	c² Ophiuchi....W.	− 57	9	19 57.93
	ι Herculis ....W.	− 45	9	38 40.04
	3 Sagittarii. ...W.	......	5	35 51.02
	δ Aurigæ ......W.	......	7	44
	9 Sagittarii ...W.	....	9	51 22.22
	γ Sagittarii.. ..W.	− 50	5	20 53 54.90
	d Sagittarii ....W.	....	8	21 09
	δ Urs. Min ....W.	....	1	16
	λ Sagittarii. ..W.	− 48	9	16 25.83
	Bradley 2333.W.	....	8	27
	51 Hev. Cephei.W.	− 40	1	28
	Moon's I. L .W.	− 50	9	37 23.72
	σ Sagittarii ...W.	.....	9	43 41.38
	ζ Sagittarii ...W.	− 50	9	50 46.53
	τ Sagittarii....W.	......	9	55 18.31

Date.	Object and lamp.	Level, one fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
Aug. 9	χ¹ Sagittarii....W.	....	9	22 13 51.39
	λ² Sagittarii....W.	− 45	9	25 17.39
	γ Aquilæ......W.	......	9	36 42.54
	b Sagittarii....W.	− 44	9	45 27.32
	λ Urs. Min....W.	− 47	1	23 06 38.0
Aug. 10	α Scorpii . ...W.	− 75	9	19 17 55.98
	τ Scorpii ......W.	− 73	9	24 16.94
	ε Scorpii.......W.	...	7	28
	ε Urs. Min....W.	− 78	8	58 20.4
	θ Ophiuchi....W.	......	9	20 10 32.17
	b Ophiuchi ....W.	.....	9	14 36.29
	c² Ophiuchi ....W.	− 60	9	19 50.53
	ι Herculis ....W.	− 53	8	38
	9 Sagittarii ....W.	.....	9	51 34.08
	δ Ur-. Min ...W	− 58	3	21 16
	λ Sagittarii ....W.	.....	7	16
	Bradley 2333.W.	.....	6	27
	51 Hev. Cephei.W.	− 55	4	28
11	51 Hev. Cephei.W.	47	1	21 28
	δ Aquilæ ......W.	41	9	22 15 36.73
	α Aquilæ ......W.	− 38	9	41 07.77
	c Sagittarii ....W.	......	4	22 51
	λ Urs. Min ....W.	− 41	4	23 06 25.1
	α¹ Capricorni ..W.	.....	2	07
	α² Capricorni ..W.	...	1	08
	π Capricorni ..W.	− 45	9	16 26.08
	Moon's I L...W.	− 43	9	21 54.06
	ν Capricorni ..W.	...	9	29 15.44
	17 Capricorni ..W.	− 41	9	35 13.06
	25 Capricorni ..W.	......	9	38 43.07
	22 Capricorni ..W.	.....	9	52 36.90
	ξ Cygni ....W.	.....	9	24 04 10.37
	α Cephei ..... W.	− 43	8	13 31.23
	θ Urs. Maj ...W.	......	6	20 23.43
	ε Capricorni ..W.	− 42	9	26 25.25
12	α Aquilæ .. ...W.	46	9	23 41 08.53
	T.Y.C.*1701.W.	− 48	8	50
	64 Aquilæ ......W.	.....	3	57
	65 Aquilæ ......W.	.....	5	23 01
	T.Y.C.*1812.W.	......	9	06 26.40
	λ Urs. Min W.	.....	1	06 26 60
	T.Y.C.*1813.W.	......	6	08 29.28
	π Capricorni ..W	.....	5	16 20.94
	ρ Capricorni . W.	− 42	5	19
	T.Y.C.*1847.W.	....	5	28
	ν Capricorni .W.	....	5	30 05.50
	α Cygni....... W.	− 44	8	33 54 97
	ω Capricorni...W.	.....	8	40 30.48
	θ Capricorni...W	− 43	9	55 16.40
	Moon's I L...W.	− 44	9	0 10 08.36
	γ Capricorni ...W.	...	9	29 22.03
	δ Capricorni . .W.	− 41	9	36 30 72
	29 Aquarii ......W.	......	9	51 56.77
	B.Y.C.*697. .W	− 39	3	1 01
	21 Cephei ......W.	...	9	03 16 58
14	α Cephei......W.	− 48	6	0 12
	λ Urs. Min....W.	− 46	1	23 06 31.3
	θ Urs. Maj....W.	.....	4	0 20 27.38
	ε Pegasi .. .. W.	− 43	9	34 23 63
	T.Y.C. *1964.W.	− 44	9	53 08.48
	θ Aquarii ......W.	......	9	1 06 41.48
	ρ Aquarii ......W.	......	9	10 04.57
	ζ Aquarii ......W.	.....	9	18 52.09
	η Aquarii ......W.	.....	6	25
	κ Aquarii ......W.	....	7	27
	Moon's II L...W.	− 41	9	42 46.21
	α Pegasi .... ..W.	− 40	9	55 02.05
	φ Aquarii......W.	.	9	2 04 10.38
	96 Aquarii......W.	− 42	9	09 28.38
	ε Piscium ......W	......	9	17 00.24
	θ Piscium ......W.	......	1	17

Transit observations—Continued.

CŒUR D'ALÊNE MISSION.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1859. Aug. 14	γ Cephei........W.	— 43	9	2 31 13.18
	γ Urs Maj.....W.	......	5	43
	30 Piscium......W.	......	9	52 01.53
	33 Piscium......W.	— 39	9	55 24 89
	α Andromedæ .W	...	3	58 25.13
	γ Pegasi .. ... W.	— 30	9	3 03 16.96
15	α Pis. Aust.....W.	......	9	1 47 11.68
	α Urs. Maj....W.	...	7	52 00 90
	B.Y.C.*1519. W.	— 35	9	2 10 20.34
	κ Piscium......W.		7	17 02.03
	Moon's II L.. W.	— 42	9	26 42.40
	ι Piscium .....W.	......	5	30 01.92
	λ Piscium......W.	......	6	32
	1 .... W.	.....	6	37 52.28
	Neptune .....W.	......	8	46 55.78
	α Andromedæ..W.	.....	9	58 26.97
	γ Pegasi ....W.	— 41	9	3 03 18.87
	α Cassiopeæ . W.	.....	9	29 55 81
	Polaris ......W.	— 41.	2	4 09 01.7
16	α Urs. Maj W.	.....	2	1 53
	T.Y.C *2085 W.	......	4	2 03
	T.Y.C. *2095 W.	— 48	7	10
	κ Piscium.. ..W.	......	7	17 03.91
	9 Piscium.....W.	— 49	4	17
	ι Piscium.....W.	.....	9	30 03.68
	λ Piscium.....W.	.....	5	32
	1 .... W.	.....	9	37 54.16
	2 ...... W.	— 48	8	37 58
	Neptune ....W.	.....	8	46 52 59
	ω Piscium.....W.	.. ..	3	49
	2 Ceti .... W.	.....	9	53 52.62
	α Andromedæ. W.	— 41	8	58 29.10
	35 Piscium.....W.	..	8	3 05 04.92
	Moon's II.L..W.	— 46	9	11 05 41
	45 Piscium.....W.	— 42	8	15 47.46
	α Cassiopeæ...W.	.....	9	29 57.01
	δ Piscium.....W.	......	9	38 43.78
	ε Urs. Maj....W.	....	3	44
	e Piscium . ..W.	— 41	9	56 28.14
	ζ¹ Piscium ....W	.....	9	4 03 43.56
	T. Y. C. *87. W	......	5	03
	f Piscium.....W.	......	9	07 53.01
	Polaris .....W.	— 44	3	09 01.9
	μ Piscium.....W.	— 45	9	29 09.43
	ν Piscium.....W.	.....	7	31 27 10
	η Urs. Maj ...W	......	1	4 39 05.6
	Aldebaran ..W.	— 49	9	7 25 11.31
17	1 .... W.	......	2	2 37
	2 Ceti ......W.	......	9	53 54.58
	α Andromedæ W.	......	9	58 30.83
	35 Piscium.... W.	— 44	7	3 05
	d Piscium.....W.	......	7	10
	45 Piscium.....W	— 44	9	15 49.60
	δ Piscium.....W.	.....	3	38 45.63
	α Cassiopeæ...W.	— 49	9	29 59 84
	ε Urs. Maj....W.	......	9	44 56.01
	ε Piscium......W.	— 44	7	53
	Moon's II L.W.	— 41	9	57 01.20
	e Piscium.. ..W.	......	2	58 29.95
	ζ¹ Piscium.....W.	......	9	4 03 45.57
	Polaris ......W.	— 46	5	09 20.1
	θ¹ Ceti...........W.	......	9	14 24.66
	μ Piscium.....W.	......	9	20 11.47
	η Piscium.....W.	.... .	3	21 20.67
	π Piscium.....W	.....	9	27 01 98
	ν Piscium. ..W	.....	9	31 29.27
	ο Piscium.....W.	.....	9	35 20 56
	η Urs. Maj... W.	......	4	39 07.50
	ι Arietis ....W.	— 41	9	47 03.14
	T. Y. C. *181. W.	......	9	52 41.41
18	T. Y. C. *50..W.	— 45	3	3 48
				h. m. s.
1859, Aug. 18	T. Y. C. *100. W.	.....	1	4
	Polaris.......W.	— 35	2	09 14.0
	η Piscium.....W.	......	9	21 22 63
	π Piscium.....W.	......	9	27 03 02
	Moon's II L. W.	— 20	9	45 30.82
	α Arietis . ....W.	— 34	9	56 40.33
	γ Arietis . ....W.	....	3	43
	ι Arietis . ....W.	......	3	47 05.50
	θ Arietis . ....W.	.....	9	5 07 43.44
	27 Arietis . ....W.	.....	8	20 31.3
	29 Arietis . ....W.	— 37	3	22
	γ Ceti ....W.	......	4	33
	β Urs. Min... W.	— 40	9	46 07.21
	Aldebaran...W.	33	5	7 25 15.60
	Capella .....W.	— 43	9	8 03 45.23
	Rigel . ...W.	.....	1	05 10.4
19	θ Arietis ....W	— 36	9	5 07 45.81
	Polaris.......W.	39	1	4 09
	27 Arietis . ....W.	— 34	9	5 20 33.82
	32 Arietis . ....W.	......	9	28 17.74
	34 Arietis . ....W.	.....	8	31
	Moon's II L. W.	— 34	9	38 08.31
	ε Arietis . ....W.	......	8	48
	δ Arietis . ....W.	.....	9	6 01 02.69
	ζ Arietis . ....W.	— 37	5	04
	α Persei ......W.	— 35	9	11 47.66
	η Tauri .. ....W.	.....	9	26 35.27
	Aldebaran...W	— 45	9	7 25 18.12
	Capella . ....W	..	3	8 03 47.79
	Rigel . ...W	— 43	9	05 12 30
	β Tauri .. ....W.	......	9	14 51.51
20	41 Arietis . ....W.	......	9	5 20 12.89
	β Urs. Min ...W.	— 47	6	48 10.38
	α Ceti ....W.	— 47	9	52 24.92
	δ Arietis . ....W.	......	6	6 01 05.29
	ζ Arietis . ....W.	......	1	04
	α Persei ......W.	.....	9	11 50.57
	Moon's II L. W.	— 45	9	35 16.80
	η Tauri .. ... W.	42	2	36 37.55
	Aldebaran...W.	— 44	9	7 25 20.28
	Capella ......W.	.....	4	8 03 50.08
	Rigel . ...W.	— 49	9	05 14.64
	β Tauri .. ....W.	.....	8	14 53.92
21	41 Arietis . ....W.	— 40	9	5 39 15.31
	β Urs. Min....W.	46	6	48 11.83
	α Ceti ....W.	45	9	52 27.18
	α Persei ......W.	48	9	6 11 53.31
	Aldebaran . .W.	48	9	7 25 22.92
	Moon's II L. W.	47	9	37 12.84
	Capella ......W.	46	8	8 03 52.63
23	δ Urs. Min....W.	93.5	1	21 17 21.8
	δ Urs. Min....W.	145.8	1	17 30.3
	δ Urs. Min....W.	—28.3	1	17 08.9
	δ Urs. Min....W.	+41.0	1	16 19.5
	δ Urs. Min....W.	80.5	1	16 43.1
	δ Urs. Min....W.	128.0	1	16 33.3
	δ Urs. Min....W.	+73.7	1	16 46.1
	δ Urs. Min....W.	—14 3	1	17 05 9
	δ Urs. Min....W.	90.8	1	17 17.9
	51 Hev. Cephei. W.	—94.5	1	28 05
	51 Hev. Cephei. W.	+51.5	1	28 30
	λ Urs. Min....W.	29 6	2	23 07 38
	λ Urs. Min.....E.	25.0	2	22 50 41
30	Sun's II L....E	+ 2	9	13 33 10.76
	β Draconis.....E	......	9	20 24 00.50
	μ Herculis.....E.	......	9	38 44.00
	γ Draconis.....E.	......	9	51 05.71
	Vega ....E.	.....	5	21 29 57.66
	51 Hev. Cephei..E.	+ 26	9	30 01.71
	δ Aquilæ........E.	......	9	22 16 12.00
	β Aquilæ ....E.	+ 48	9	46 12.29

Transit observations—Continued.

CŒUR D'ALÊNE MISSION.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
Aug. 30	γ Cygni . ... E.	......	9	23 14 58.06
	α Cygni . ... E.	+ 36	9	34 25.16
31	Sun's II L... E.	− 21	5	13 36
	μ Herculis ...... E	+ 34	9	20 38 46.87
	γ Draconis..... E.	......	9	51 07 68
	Vega .... E.	......	9	21 29 50 46
	δ Draconis...... E.	.....	9	22 10 15.70
	δ Aquilæ .. ... E.	+ 37	5	16
	γ Aquilæ .... E	......	9	37 24.84
	α Aquilæ........ E.	......	8	41
	β Aquilæ .. ... E.	+ 40	8	46
	γ Cygni . ... E.	......	9	23 15 00.69
	α Cygni......... E	......	7	34
Sept. 1	Sun's II L... E.	− 1	9	13 40 32.74
	γ Draconis .. . E.	+ 27	9	20 51 11.18
	Vega .... E.	....	8	21 30 04.06
	ζ Aquilæ .. .. E.	......	9	56 50.43
	δ Draconis..... E	......	9	22 10 19.43
	β Cygni .... E.	+ 31	9	22 56.98
	γ Aquilæ .... E.	......	9	37 27.78
	α Aquilæ .. .. E.	+ 33	9	41 48.71
	θ Aquilæ .... E.	......	9	23 01 56.71
	γ Cygni . ... E.	.....	...	15 04.09
	α Cygni....... E.	+ 36	9	34 31.07
2	γ Draconis .. .. E	9	9	20 51 14.98
	Vega .... E.	+ 4	8	21 30 07.71
	β Cygni . ... E.	......	8	22 23
	α Aquilæ. .... E.	+ 19	9	41 52.88
3	Sun's I L.... E	− 13	5	13 45 46.21
	Spot .... E.	. ....	5	47 35.50
	Sun's II L... E.	+ 12	8	47 54.83
	δ Urs. Min. ..... E.	+ 19	2	21 15
	51 Hev. Cephei.. E	......	3	31
	Vega .. .. E.	+ 22	9	30 11.34
	δ Draconis .. .. E.	......	8	22
	δ Aquilæ........ E.	+ 23	9	16 25.00
	γ Aquilæ .. .... E.	...	9	37 35.67
	α Aquilæ .. ... E.	.....	9	41 56.72
	β Aquilæ .. ... E.	+ 23	9	46 25.70
	θ Aquilæ ...... E.	......	9	23 02 03.66
	α¹ Capricorni ... E.	......	9	07 58 21
	γ Cygni . ... E.	....	9	15 12.31
	T.Y.C. * 1941.. E.	......	9	26 45.79
	α Cygni......... E	+ 26	9	34 30.67
	α Cephei .. .... E.	....	9	0 13 13.31
	β Cephei ...... E	+ 36	9	24 48.69
4	Sun's I L.... E	+ 20	3	13 49 27.07
	Spot .... E.	......	2	51 05.25
	Sun's II L... E.	+ 31	9	51 35.22
	Vega .... E	47	9	21 30 14.63
	51 Hev. Cephei.. E	+ 48	3	38
	δ Draconis...... E.	......	9	22 10 30.19
	δ Aquilæ ...... E.	....	6	16
	β¹ Cygni . ... E.	......	9	23 07.07
	β² Cygni........ E.	+ 53	9	23 09.40
	γ Aquilæ .. .... E.	......	9	37 39 27
	α Aquilæ .. . .. E.	......	9	41 59.92
	β Aquilæ .. .... E.	+ 56	9	46 26.88
	θ Aquilæ .. ... E.	......	9	23 02 07.66

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.
Sept. 4	γ Cygni ... . E.	......	9	23 15 15.77
	α Cygni......... E.	......	9	34 41.29
5	Sun's Spot... E.	+ 16	6	13 54 30.47
	Sun's II L.. E.	17	9	55 15.30
6	Sun's I L..... E.	+ 6	9	13 56 47.52
	Sun's Spot... E.	.....	8	57 04.50
	Sun's Spot... E.	......	2	58 01.90
	Sun's II L... E.	+ 3	6	58 55.27
8	α¹ Capricorni ... E.	......	7	23 08 00.30
	π Capricorni ... E	......	8	17 34.15
	ν Capricorni ... E.	+ 22	7	20 29.35
	Moon's I L... E.	+ 13	9	55 [illegible]
	ι Capricorni ... E.	......	7	0 12 43 20
	ζ Capricorni ... E.	.....	8	16 56 31
	ε Capricorni ... E	+ 3	9	27 30.13
	γ Capricorni ... E.	......	2	30 35.00
9	Vega .... E.	− 5	9	21 30 31.98
	α Aquilæ .... E.	......	8	22 42 15.86
	β Aquilæ .. .. E.	− 5	9	46 45.31
	α¹ Capricorni ... E.	− 4	9	23 08 11.19
	α² Capricorni .. E.	......	....	08 35.00
	γ Cygni ... . E	......	5	15
	α Cygni .... E.	− 4	9	35 00.35
	ν Aquarii ...... E.	− 4	4	0 00
	α Cephei .. .. E.	......	9	13 25.30
	β Cephei. ..... E.	− 4	9	0 25 11.52
	γ Capricorni ... E.	− 3	4	30 37.78
	δ Capricorni ... E	....	9	37 38.70
	Moon's I L... E.	− 2	9	41 55.30
	ι Aquarii ... .. E.	.....	9	57 10.56
	θ Aquarii ... .. E.	.....	9	1 07 45.44
	ρ Aquarii ... .. E.	....	3	11
10	Sun's I L ... E.	− 41	1	14 10 24.0
	Sun's Spot.. E.	......	2	....
	Sun's Spot... E.	.....	3	....
	Sun's II L... E.	− 31	2	....
11	α Pis. Aust...... E.	+ 14	9	1 48 16.46
	α Urs. Maj...... E.	16	6	53 32.25
	φ Aquarii ... .. E	15	9	2 05 58.08
	Moon's I L... E	17	9	11 24.94
	ε Piscium . .... E	+ 21	8	18 00.25
	λ Piscium . ..... E.	......	9	33 18.57
	20 Piscium . ..... E.	.....	9	38 08.89
	Neptune ...... E.	.....	9	45 34.10
	27 Piscium ...... E	......	5	49
	30 Piscium . ... E.	...	7	53
	33 Piscium . .. E.	+ 15	7	56
	α Cassiopeæ ... E	.....	6	3 30 59.52
	Polaris. .... E.	+ 18	9	4 05 26.3
12	Sun's Spot... E.	− 54	2	14 15
	Sun's Spot... E.	......	8	19 25.75
	Sun's II L... E.	− 54	4	20 47.9
	α Urs. Maj...... E.	+ 19	9	1 53 35.48
	γ Cephei .. .. E.	20	9	2 38 02.53
	Moon's II L.. E.	+ 24	9	57 58.40
	α Andromedæ.. E.	....	2	59 37.1
	γ Pegasi . ..... E.	+ 22	8	3 04
	Polaris........ E.	+ 22	2	05 26 1
	α Cassiopeæ . .. E.	.....	8	31 01.23

SOHON'S PASS.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
Oct. 7	Moon's I L.. W.	+ 28	1	1 14
	ζ Pegasi .. ... W.	......	8	25
	α Pegasi ...... W.	.....	8	38
	α Andromedæ . W.	+ 44	9	3 00 38.67
	γ Pegasi ...... W.	.....	9	06 50.30
8	γ Aquilæ . .... W.	− 2	6	22 41

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
Oct. 8	λ Urs. Min..... W.	+ 2	5	22 05
	α Cygni ...... W.	......	6	23 28.65
	ζ Cygni ...... W.	....	9	0 03 53.84
	α Cephei ...... W.	......	6	13 30.05
	σ Aquarii .. .. W	......	9	1 20 08.12
	κ Aquarii .. .. W.	+ 4	9	27 24.59

Transit observations—Continued.

SOHON'S PASS.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.		
				h.	m.	s.
1859. Oct. 8	Moon's I L. . . W.	+ 3	6	1	53	
	φ Aquarii . . . . W.	......	9	2	03	58.08
	κ Piscium . . . . W.	......	9		16	39.46
	T.Y.C. *2101 . W.	......	3		15	
	λ Piscium . . . . W.	......	9		31	48.31
	20 Piscium . . . W.	......	8		37	
	Neptune . . . . W.	......	3		41	
	Polaris . . . . . W.	......	1	4	00	
9	Sun's I L. . . . W.	− 11	6	15	54	
	Sun's Spot . . W.	......	6		55	
	Sun's II L. . . W.	− 29	2		56	
	λ Urs. Min . . . W.	23	3	23	06	
	α² Capricorni . . W.	− 30	2		07	
	α Cygni . . . . . W.	......	9		33	35.51
	ζ Cygni . . . . . W.	......	9	0	03	53.71
	α Cephei . . . . W.	......	6		12	
	β Cephei . . . . W.	......	4		24	
	β Aquarii . . . . W.	......	9		21	03.67
	ε Pegasi . . . . W.	......	8		34	
	α Aquarii . . . . W.	− 16	9		55	28.10
	φ Aquarii . . . . W.	......	9	2	03	56.98
	κ Piscium . . . . W.	......	9		16	37.98
	T.Y.C. *2101 . W.	......	9		16	57.02
	γ Cephei . . . . W.	......	7		30	
	Moon's I L. . . W.	− 9	7		37	55.96
	27 Piscium . . . W.	......	6		48	
	33 Piscium . . . W.	......	9		55	03.24
	44 Piscium . . . W.	......	9	3	15	06.92
	Polaris . . . . . W.	......	2	4	10	
10	Sun's II L. . . W.	− 15	5	16	00	
	α Piscium . . . . W.	......	2	3	10	
	44 Piscium . . . W.	......	9		15	04.54
	Moon's I L. . . W.	− 18	9		23	27.36
	α Cassiopeæ . . W	......	6		30	
	β Ceti . . . . . . W.	− 14	2		37	
	ι Piscium . . . . W.	......	9		52	32.08
	ε Piscium . . . . W.	......	9		58	00.90
	ζ¹ Piscium . . . W.	......	9	4	03	16.49
	T.Y.O. *87 . . W.	......	9		03	17.54
	θ¹ Ceti . . . . . . W.	......	9		13	52.44
	μ Piscium . . . . W.	......	9		19	42.49
	Polaris . . . . . W.	− 16	3		10	
	ν Piscium . . . . W.	......	9		31	00.41
	W.	......	9		35	12.07
	α Arietis . . . . W.	......	9		56	09.28
	ξ¹ Ceti . . . . . . W.	......	4	5	02	
	γ Ceti . . . . . . W.	......	9		32	53.68
	β Urs. Min . . W.	− 20	9		47	22.28
12	Polaris . . . . . W.	− 28	4	4	09	12.5
	θ¹ Ceti . . . . . . W.	......	6		13	
	η Piscium . . . . W.	......	9		20	49.67
	π Piscium . . . . W.	− 21	4		25	31.05
	ι Arietis . . . . . W.	......	3		46	31.93
	Moon's II L. . W.	− 23	9	5	03	58.44
	θ Arietis . . . . . W.	......	4		07	10.73
	γ Ceti . . . . . . W.	......	7		32	
	π Arietis . . . . . W.	......	9		36	18.43
	ξ¹ Arietis . . . . W.	......	9		45	21.06
	β Urs. Min . . . W.	......	4		47	23.15
	53 Arietis . . . . W.	......	6		56	
	α Persei . . . . . W.	......	7	6	11	11.53
	γ Urs. Min . . . W.	− 21	4		17	
	δ Eridani . . . . W.	......	9		33	20.08
	ζ Urs. Min . . . W.	......	8		45	
	T.Y.C.* 270 . W.	......	9	7	04	29.42
13	Sun's I L. . . . W.	− 26	9	16	09	15.00
	Sun's Spot . . W.	......	5		10	
	Sun's Spot . . W	......	4		10	00.00
	Sun's II L . . W.	+ 19	3		11	
	T.Y.C.* 266 . . W.	− 5	9	5	27	40.58
	π Arietis . . . . . W	......	9		38	16.97
1859. Oct. 13	ξ² Arietis . . . . . W.	......	7	5	45	
	ε Arietis . . . . . W.	......	7		48	
	53 Arietis . . . . W.	......	4		56	
	Moon's II L. . W.	......	9		58	35.47
	ζ Arietis . . . . . W.	+ 7	7	6	03	
	τ¹ Arietis . . . . W.	......	7		09	
	9 Tauri . . . . . . W.	......	7		25	
	17 Tauri . . . . . W.	......	8		33	
	24 Tauri . . . . . W.	......	3		35	
	η Tauri . . . . . . W.	......	9		35	56.22
	ζ Urs. Min . . . W.	......	5		45	
	T.Y.C.* 355 . W.	+ 8	9	7	01	25.77
	Aldebaran . . . W.	......	9		24	40.96
	ε Urs. Min . . . W.	+ 4	5		56	
	Capella . . . . . W.	......	4	8	03	
	Rigel . . . . W.	......	5		04	
	β Tauri . . . . . . W.	......	4		14	
	α Leporis . . . . W	......	9		23	19.42
	ε Orionis . . . . W	......	4		25	
14	Sun's I L. . . . W.	− 2	7	16	12	
	Spot . . . . W	......	1		13	
	Spot . . . . W.	......	8		13	
	Spot . . . . W.	......	7		13	
	Spot . . . . W.	......	3		14	
	Sun's II L . . . W.	+ 19	4		15	
15	Sun's I L . . . . W.	− 9	2		16	
	Sun's Spot . . W	......	2		17	
	Sun's Spot . . W.	......	2		17	
	Sun's Spot . . W.	......	4		18	
	Sun's II L . . . W.	+ 5	4		18	
19	ε Pegasi . . . . . W.	− 6	5		34	
	T.Y.C. *1990 . W.	......	7	1	02	
22	ζ Cygni . . . . . W.	− 40	9		03	52.94
	α Cephei . . . . . W.	......	8		19	
	β Cephei . . . . . W.	− 25	4		23	
23	Sun's I L. . . . W.	− 30	9	16	46	52.40
	Sun's Spot . . W.	......	9			54.93
	Sun's Spot . . W.	......	5			53
	Sun's Spot . . W	......	5		48	
	Sun's II L. . . W.	......	5		49	
	α Cygni . . . . . W.	− 44	9	23	23	33.80
	γ Urs. Min . . . W.	......	1	......	......	......
	ν Aquarii . . . . W.	− 37	9		58	51.61
	ζ Cygni . . . . . . W.	......	9		03	54.24
	ζ Capricorni . . W.	......	9		15	34.57
	β Cephei . . . . . W.	......	9		23	50.33
	ε Pegasi . . . . . W.	......	9		34	13.60
	μ Capricorni . . W.	......	9		42	34.78
	α Aquarii . . . . W	− 34	9		55	30.67
	θ Aquarii . . . . W.	......	9	1	06	[illegible]
	ρ Aquarii . . . . W.	......	8		09	
	53° Aquarii . . . W.	......	9		15	53.51
	κ Aquarii . . . . W.	......	9		27	26.13
	ξ Pegasi . . . . . W.	......	8		31	
	α Pis. Aust . . . W.	......	2		46	
	T. Y. O. *947. W.	−37.0	9	2	09	31.03
	χ Draconis . . . W.	......	4		19	
	λ Cephei . . . . . W.	......	6		20	
	Neptune . . . . W.	......	6		40	
	Polaris . . . . . . W.	− 37	1	3	05	53.3
	Polaris . . . . . . W.	− 12	2		22	03.2
	Polaris . . . . . . W.	+ 45	3		36	54.8
	Polaris . . . . . . W.	− 6	4		53	01.3
	Polaris . . . . . . W.	− 19	5	4	08	52.1
	Polaris . . . . . . E.	− 1	6		18	54.6
	Polaris . . . . . . E.	− 20	7		34	25.3
	Polaris . . . . . . W.	− 21	7		44	32.6
	Polaris . . . . . . W.	− 26	8	5	00	29.6
	Polaris . . . . . . E.	− 11	9		09	23.5
	Polaris . . . . . . W.	− 18	9		15	43.5
24	Sun's I L. . . . W.	− 6	6	16	50	

Transit observations—Continued.

SOHON'S PASS.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1859.				h. m. s.	1859.				h. m. s.
Oct. 24	Sun's Spot .. W.	... ..	7	16 50	Oct. 26	Uranus?. .... W	......	7	7 16
	Sun's II L... W.	— 12	6	53		Sun's I L.... W.	+ 13	6	16 58
25	μ Capricorni... W.	— 37	9	0 42 31.60		Spot (5)..... W.	......	....	....
	ε Aquarii...... W.	— 31	7	55	30	Sun's II L .. W.	+ 4	8	17 00
	θ Aquarii ... . W.	......	9	1 06 19.51		Sun's I L.... W.	......	5	17 13
	ρ Aquarii...... W	— 31	2	1 09		Spot (J) .... W.	.....	....	....
	T. Y. C.*2061 W.	— 18	4	46		Sun's II L .. W.	......	7	16
	T. Y. C.* 2061 E.	— 21	4	44		λ Draconis .... W.	...	9	20 50 25.44
	T. Y. C.*947 . E.	— 33	3	2 10		Moon's I L .. W.	+ 45	6	21 29
	T. Y. C.*947. W.	......	1	08		β Lyræ .... W.	.....	9	42 04.28
	γ Cephei ...... W.	......	6	29		ζ Aquilæ..... W.	.. ..	8	56
	Neptune .... W.	......	7	40		δ Aquilæ ...... W	......	8	22 15
	34 Piscium .. .. W	......	9	59 49.74		h² Sagittarii . .. W.	....	6	25
	Polaris ..... W.	— 26	1	3 07 24.2		λ Aquilæ....... W.	......	9	36 50 94
	Polaris....... E	— 20	2	15 18.2		α Aquilæ....... W.	......	9	41 11.66
	Polaris . .... W.	— 26	2	24 26.3		δ Sagittarii.... W	.....	8	45
	Polaris....... E.	— 20	3	30 68.6		ε Sagittarii... W.	....	9	51 24.30
	Polaris . .... W.	— 29	3	40 66.4		α Aquarii ..... W.	+ 2	9	0 55 53.91
	Polaris....... E	— 23	4	49 56.9		α Hydræ .... W.	......	9	12 15 50.67
	Polaris . .... W.	— 30	4	53 23.4		λ Urs. Min .... W	+ 41	6	23 16 46.2
	Polaris . .... W	— 36	5	4 08 57.1		Urs. Min. .... E	+ 42	7	27 49.3
	Polaris....... E.	— 2	6	17 56.4		Urs. Min.... E.	+ 6	8	47 48.8
	Polaris . .... W.	+ 6	6	24 43.3	30	Urs. Min .... W	— 4	8	23 57 32.3
	Polaris....... E	+ 20	7	34 44.0		Urs Min .... W	+ 1	9	3 18 26.2
	Polaris . ... W.	— 20	7	40 42.8		α Cygni . ... E	.....	7	23 23
	Polaris...... E.	+ 19	8	49 29.6		α Cephei .... W.	+ 1	9	0 12 18.62
	Polaris . .... W.	+ 4	8	56 07.3		β Cephei ...... W.	....	9	23 40.41
	Polaris....... E.	+ 20	9	5 04 49.7		θ Urs. Maj..... W.	— 5	3	12 20
	Polaris . ..... W.	— 20	9	12 46.7		λ Urs. Maj..... W.	— 3	5	14 43
	γ Ceti .. .. W.	......	9	23 01.81		Mars .... W	......	4	15 10
	β Urs. Min ..... W.	.....	9	47 31.27		Polaris . ..... W.	......	3	16 09
	α Persei....... W.	......	9	6 11 24.09		Polaris....... E.	.....	3	16

Prime vertical observations.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
26	Vega .... W., S.	......	9	0 14 34.41		T. Y. C.*280 W., S.	......	9	10 09
	Vega .... W., S.	......	4	22 03.37		T. Y. C.*435 W., S.	......	8	45
	α Cygni.... W., S.	+ 23	9	1 11 59.98		η Tauri .... W., S.	......	9	11 01 34.44
27	α Cygni..... E., S.	+ 41	7	21 57 21.67		Jupt. cent. W., S.	+ 34	9	15 21 11.62
	α Cor. Bor . W., S.	+ 33	9	22 34 16.92		Arcturus. W., S.	+ 53	....	21 46 52.37
	Vega ..... W., S.	......	9	0 21 16.94	29	α Cygni .... E., S	+ 55	7	56 34.67
	T. Y. C.*1630 W., S.	......	7	20		α Andromedæ E., S.	— 26	6	22 57 01.67
	α Cygni .... W., S	+ 31	5	1 12 04.42		Vega..... W., S.	— 6	9	0 20 31.04
	α Cygni.... W., S.	+ 29	2	1 11 14.70		Vega .... W., S.	......	2	17 50.7
	η Tauri..... E., S.	......	8	2 08 41.36		Vega ... W., S.	......	8	19 55.95
	Tauri..... E., S.	.....	8	09 27.73		α Cygni .... W., S.	......	9	1 11 22.67
	Tauri..... E., S.	.....	8	10 51.25		η Tauri...... E. S	....	3	2 11 24.57
	Aldebaran. E., S.	+ 19	9	27 05.16		Aldebaran E., S.	— 3	9	27 11.34
28	α Cor. Bor.. W., S	+ 39	4	22 33 29.72		Uranus ... E., S.	......	2	45
	Vega..... W., S.	+ 30	8	0 20 27.71		? .... E., S.	......	9	57
	α Arietis... E., S.	......	2	27 21.5		ζ Cygni.... W., S.	......	4	3 58
	T. Y. C.*56 E., S.	......	9	47		β Tauri....... E. S.	....	9	4 14 15.62
	α Cygni .... W., S.	+ 32	5	1 11 18.72		Jupt. cent . E., S.	— 9	9	6 05 32.59
	η Tauri...... E., S.	......	5	2 11 22.00		Moon (?)	.....	7	09 01.67
	α Aldebaran. E., S.	......	1	27 09.7		Capella ... E., S	.....	9	47 42.37
	Capella .. W., S.	......	2	9 19 32.80		Jupiter... W., S.	— 22	9	15 21 27.98
	α Arietis ... W., S.	+ 36	9	25 49.08					

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
Nov. 4	?* .... W.	......	6	1 18	Nov. 4	β Ceti......... W.	......	9	3 38 42.11
	?* .... W.	......	9	23 25.67		Polaris...... W.	+ 4	8	4 55 25.80
	?* .... W.	......	8	28	5	Sun's I L... W.	......	1	17 26
	Moon's I L.. W.	— 1	9	37 31.30		Sun's Spot.. W.	......	5	28
	α Pis. Aust.... W.	......	9	50 50.73		Sun's II L... W.	.....	6	30
	α Pegasi ...... W.	....	5	56	6	α Cephei ...... W.	.....	9	0 11 07.35
	φ Aquarii ..... W.	+ 3	9	2 06 33.83		θ Urs. Maj.... W.	......	5	19
	γ Cephei ...... W.	......	5	31		β Cephei .... . W.	— 11	4	21
	30 Piscium..... W.	......	9	40 04.12		ε Pegasi...... W.	......	5	23
	Polaris...... W.	......	9	3 10 57 0		α Aquarii ..... W.	+ 3	9	24 22.57

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1859. Nov. 6	θ Aquarii ...... W.	......	9	1 05 13.84
	ρ Aquarii ...... W.	......	9	08 36.90
	53 Aquarii, cent. W.	......	9	14 45.66
	ζ Pegasi .... W.	......	3	30
	α Pis. Aust. .. W.	......	9	45 42.63
	α Urs. Maj .... W.	+ 6	7	50
	T. Y. C. *2088 W.	......	9	2 03 42.06
	T. Y. C. *2115 W.	......	9	26 33.82
	λ Piscium .... W.	......	7	30
	20 Piscium .... W.	......	9	36 32.00
	Neptune .... W.	− 1	1	39
	Moon's I L. . W.	− 8	9	3 02 48.90
	44 Piscium .... W.	.....	9	14 01.77
	α Cassiopeæ... W.	......	9	28 27.86
	δ Piscium .... W.	......	3	37
	ε Piscium .... W.	......	9	56 57.67
	ζ¹ Piscium .. . W.	......	9	4 02 13.36
	Polaris....... W.	− 2	5	07
7	Moon's I L. W.	− 8	9	3 49 46.42
	ζ¹ Piscium...... W.	.....	7	4 02
	θ¹ Ceti.......... W.	......	9	12 49.20
	μ Piscium .... W.	......	9	18 28.50
	η Piscium .... W.	.....	2	19
	π Piscium .... W.	− 2	7	25
8	Sun's II L... W.	46	3	17 50
	Moon's I L. W.	− 16	9	4 39 34.01
	α Arietis ...... W.	......	7	55
	Polaris....... W.	.....	2	16 01
9	γ Cephei .... W.	− 2	9	2 29 41.20
	α Andromedæ. W.	0	9	56 52.86
	γ Pegasi .... W.	.....	9	3 01 44.77
	α Cassiopeæ... W.	......	9	28 24.22
	Polaris....... W.	.....	2	4 07
	Polaris....... W.	......	6	07
	θ¹ Ceti .... W.	......	6	12
	ι Arietis .... W.	......	9	45 26.36
	α Arietis .... W.	......	5	55
	θ Arietis ...... W.	......	9	5 06 04.29
	Moon's I L... W.	+ 22	9	33 19.57
	Moon's II L. imperfect.. W.	.....	4	35
	ρ³ Arietis..... W.	......	5	44
	ι Arietis....... W.	......	5	46
	53 Arietis .... W.	......	1	5 55
	δ Arietis .... W.	......	9	59 21.77
	ζ Arietis .... W.	. ...	6	6 02
	τ¹ Arietis .... W.	......	9	08 52.77
	ζ Urs. Min .... W.	......	9	44 23.90
	Uranus....... W.	......	8	7 14
10	Moon's II L W.	+ 10	9	6 33 57.06
	Polaris .... W.	+ 37	5	16 00
	η Urs. Maj .... W.	......	1	16
	Arcturus .... W.	......	4	17 04
	β Urs. Min .... W.	......	....	46
11	Sun's I L.... W.	+ 68	8	18 00
	Spots.......... W.	......	....	....
	Sun's II L.. W.	......	9	02 32.52
	Venus ... .. W.	......	8	48
	Vega......... W.	+ 45	9	21 27 46.19
	γ Ceti.......... W.	......	9	5 31 38.73
	β Urs. Min .... W.	.....	9	46 19.20
	α Persei....... W.	......	9	6 09 56.63
	9 Tauri .... W.	.....	5	24
	17 Tauri .... W.	......	9	33 10.06
	η Tauri .... W.	......	9	34 46.12
	γ¹ Eridani ..... W.	......	9	47 05.13
	η Draconis.... W.	......	9	7 17 22.84
	Aldebaran .. W.	......	9	23 28.64
	Moon's II L. W.	.. ...	9	36 22.94
	ι Aurigæ .... . W.	......	9	43 26.63
	Capella....... W.	......	4	8 01
1859. Nov. 11	Rigel .... W.	......	8	8 03
	β Tauri .... W.	......	9	13 02.12
	δ Orionis....... W.	... ..	9	20 26.23
	α Leporis..... W.	......	4	8 22
	α Columbæ ... W.	......	9	30 10.66
	136 Tauri .... W.	......	9	40 07.57
	Polaris....... W.	− 7	5	16 00
	β Urs. Min.... W.	......	2	17 46
12	Sun's I L... W.	+ 42	7	18 04
	6 Spots .... W.	......	...	....
	Sun's II L.. W.	......	8	06
	Venus, cent . W.	......	9	53 40.16
	Mercur ,cent. W.	......	9	19 19 42.63
	τ Tauri........ W.	......	9	7 29 22.06
	ι Aurigæ ...... W.	.....	9	43 25.12
	ι Tauri........ W.	......	8	50
	Capella ...... W.	......	8	8 01
	β Tauri........ W.	......	8	12
	Moon's II L. W.	......	9	41 18.09
	δ Orionis . ... W.	......	2	20
	1 Geminorum.. W	......	4	51
	μ Geminorum.. W.	......	9	9 09 50.97
	49 Aurigæ ..... W.	......	1	21
	ε Geminorum . W.	......	5	30
	Sirius......... W.	......	9	34 28.91
13	δ Orionis . W.	......	2	8 20
	Moon's II L. W.	+ 33	7	9 46
	δ Geminorum.. W.	......	5	10 07
	ι Geminorum.. W.	......	2	12
	α² Geminorum.. W.	......	9	21 11.17
	β Geminorum.. W.	......	8	32
	Jupiter, cent. W.	+ 44	9	44 31.03
15	Sun's II L.. W.	+ 60	5	18 18
16	Sun's I L... W.	+ 24	8	20 49
	Sun's 5 spot. W.	......	....	....
	Sun's II L W.	+ 31	9	23 05.49
21	Sun's I L... W.	......	8	41
	Sun's 4 spot. W.	......	..	....
	Sun's II L.. W.	......	8	44
22	Polaris..... W.	......	1	....
	Arcturus .... W.	......	5	17 05
	β Urs. Min .. W.	......	7	47
	ε Bootis ...... W.	.....	8	34
	Sun's I L... W.	......	9	18 50 20.60
	Sun's 6 spot. W.	......	....	....
	Sun's II L.. W.	+ 44	8	52
26	ε Bootis .... W.	......	9	17 34 54.06
	β Urs. Min.... W.	+ 52	9	47 25.04
	α Serpentis ... W.	+114	4	18 33
27	Sun's I L... W.	......	9	19 07 23.29
	Sun's 3 spot. W.	......	....	....
	Sun's II L.. W.	.....	9	09 43.07
	η Draconis .. W.	[illegible]	2	19
	Venus, cent. W.	+ [illegible]	9	20 14 18.06
	α Ophiuchi.... W.	.....	9	24 26.59
	Mercury .... W	......	6	41
	Vega .... W.	.....	9	21 28 15.01
	Moon's I L.. W.	− 3	9	50 19.47
	α Aquilæ...... W.	.....	9	22 39 56.62
	ν Aquari . .... W.	......	9	23 58 00.11
	ι Capricorni .. W.	.....	6	0 10
	ζ Capricorni .. W.	.....	9	14 42.86
	θ Urs. Maj .... W.	......	4	19
	β Cephei . .... W.	+ 22	3	22
	Polaris....... W.	......	1	16
	Arcturus.... W.	......	9	17 05 18.12
	ε Bootis .... W.	......	9	34 54.73
	β Urs. Min.. . W.	+ 16	8	47
28	Sun's I L.. W.	+ 26	9	19 11 39.70
	Sun's spot .. W.	......	....	....
	Sun's II L.. W.	......	6	13

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1859. Dec. 1	Sun's I L...W.	......	8	19 24
	Sun's II L..W.	— 21	9	26 03.19
	Venus I L...W.	— 26	9	20 36 17.73
	Venus II L..W.	......	9	36 18.35
	Vega ....W.	......	9	21 28 24.04
	α Aquilæ......W.	......	9	22 40 06.80
	β Cephei . ....W.	......	8	0 23
	ε Pegasi ......W.	......	5	33
	μ Capricorni ..W.	......	8	41
	α Aquarii .....W.	......	8	54
	θ Aquarii .....W.	......	9	1 05 36.31
	ρ Aquarii .....W.	..	9	08 59.34
	Moon's I L..W.	— 8	9	15 05.90
	α Pisi. Aust...W.	.....	9	46 04.00
	φ Aquarii .....W.	......	9	2 03 14.27
	ψ³ Aquarii .....W.	.....	8	07
3	Vega ....W.	— 26	9	21 28 25.6
4	ι Piscium......W.	......	8	2 28
	γ Cephei . ....W.	......	1	....
	Moon's I L..W	.....	4	3 28
18	Sun's I L....E.	......	8	20 40
	Sun's II L...E.	......	6	43
	Vega ....E	......	9	21 29 06 77
	Venus ....E.	+ 8	9	22 10 49.84
	α Aquilæ ....E.	+ 84	9	41 09.58
	α Cygni . ...E	......	9	23 33 31.51
19	α Pis Aust.....E.	......	9	1 46 55.49
	α Urs. Maj.....E	......	5	52
	ι Piscium .....E.	.. ..	9	2 29 43.76
	α Cassiopeæ ...E.	......	5	3 29
	Polaris. ......E.	.....	9	58 09.05
31	Vega ... .E	.....	9	21 30 14.53
	Sun's I L....E.	......	9	30 11.31
	Sun's 3 spot..E.	....	...	....
	Sun's II L...E	+ 34	9	41 32.49
	α Aquilæ .. ....E	+ 24	9	22 43 07.32
	Venus ....E.	......	9	23 21 02.98
	α Cygni . ...E	......	9	34 41.93
	ε Pegasi . .... E.	......	7	0 35
	ζ Pegasi . .....E.	......	8	1 30
	α Urs. Maj.....E	......	7	53
	κ Piscium . ....E	+ 28	2	17
	ι Piscium . ....E.	......	9	30 56.92
	γ Cephei .. ....E.	.....	3	31
	Moon's I L...E.	— 5	9	3 10 32.69
	δ Piscium . ....E.	......	7	39
	ε Piscium . ....E.	......	9	53 53.73
	e Piscium . ....E.	......	8	59
1860.	Polaris .. ....E.	.....	3	4 09
Jan. 2	Venus ....E	+ 71	9	23 31 35.06
	Moon's I L ..E	— 9	9	4 45 06.10
5	Sun's II L ...E	61	8	23 04
	θ¹ Ceti ....E.	2	4	4 15
	θ¹¹ Ceti ....E.	4	2	15
	Moon's I L ..E.	— 15	9	7 39 30.04
	ι Aurigæ ....E.	......	7	46
	ι Tauri.........E.	.....	1	53
	Capella . ....E.	......	9	8 06 07.42
6	Moon's I L ..E.	— 11	9	8 46 22.50
	η Geminorum..E	......	8	9 05
	μ Geminorum..E.	......	7	13
	ν Geminorum..E.	......	6	19
	ε Geminorum. E.	......	8	34
	Sirius ....E	— 14	8	37
8	Sun's I L ....E.	......	7	23 15
	Sun's 2 spots.E.	......	..	....
	Sun's II L .. E	+ 12	8	17
9	Sun's I L ...E.	.....	8	23 19
	Sun's 3 spots.E.	......	....	....
	Sun's II L ..E.	....	9	22 03.84
	Venus ....E.	+ 60	8	0 08
1860. Jan. 9	Mars ....E.	......	9	17 50 56.31
	β Libræ ....E.	....	8	18 08
	α Cor. Bor......E.	......	8	28
	Mercury .....E.	......	4	20 49
	Vega ....E.	.....	9	21 31 24.06
12	Vega ....E.	— 19	9	21 31 42.29
28	Moon's I L ..E.	+126	9	3 41 23.36
	α Arietis...... E	....	9	5 00 29.58
	ξ¹ Ceti ....E.	......	9	06 47.09
	ξ² Ceti ....E.	.....	1	21
	γ Ceti ....E.	......	9	37 15.05
	α Ceti ....E.	.....	9	56 11.18
	17 Tauri. ....E.	....	9	6 37 47.96
	η Tauri ....E.	.....	7	40
	γ¹ Eridani ......E	.....	9	53 42.31
	Aldebaran ...E.	......	9	7 29 07.82
	Capella ....E	......	5	8 07
	Vega ....E.	.....	1	21 33
	α Cygni ....E.	.. ..	7	23 37
29	Sun's I L ...E.	...	9	23 46 41.53
	Sun's 3 spots..E.	......	...	....
	Sun's II L .. E.	— 78	8	48
	α Pegasi.........E.	—170	4	1 58
	α Cassiopeæ ...E.	—142	4	3 33
	Polaris ...... E.	+ 10	2	4 04
	Palaris.......W.	0	1	11
	η Piscium ... .E	+ 3	5	25
	Moon's I L . .E.	......	9	27 55.44
	ο Piscium .....E.	.....	9	39 14.40
	ι Arietis ....E	.....	9	50 56.36
	α Arietis.......E.	......	9	5 00 31.11
	ξ¹ Ceti ....E.	....	9	06 40.76
	θ Arietis.......E.	......	9	11 34.96
	38 Arietis........E.	.....	9	28 35.41
	β Urs. Min.....E.	......	9	52 54.98
	Vega ....E.	.....	9	21 33 27.34
	α Aquilæ ....E.	......	9	22 45 15.46
	α Cygni.........E.	+ 45	8	23 37
30	Sun's I L ....E.	......	9	23 50 52.40
	Sun's 3 spot ..E.	.....	....	....
	Sun's II L ...E.	+ 40	8	53
	Venus ...... E.	— 50	1	1 50
	Polaris.......E	...	1	3 01 30.3
	Polaris ......E.	.....	3	33 15.9
	Polaris........E.	— 17	4	49 01.5
	Polaris ....W.	— 23	4	56 15.5
	Polaris ...... E.	...	5	4 04 22.4
	Polaris ....W.	— 23	5	12 02 7
	Polaris ....E.	— 17	6	20 07.3
	Polaris ....W.	26	6	27 31.4
	Polaris. ....E.	9	7	36 31.8
	Polaris .. ...W.	— 23	7	43 28.9
	α Arietis ....W.	......	9	5 00 46.21
	θ Arietis ....W.	— 25	3	11
	Moon's I L. .W	......	9	17 39 44
	ξ² Arietis .. ...W.	......	9	50 03.70
	ε Arietis ......W.	.....	5	58
	53 Arietis ......W.	......	9	6 01 04.40
	δ Arietis ......W.	.....	2	05
	ζ Arietis ......W.	.. ...	3	08
	α Persei ......W.	.....	8	15
	9 Tauri.........W.	......	3	20
	α Cygni ....W.	+ 35	8	23 28
31	Sun's I L ....W.	.....	2	55
	Sun's spot....W.	....	....	....
	Venus........W.	— 22	9	1 55 26.13
	γ Ceti ....W.	— 21	6	5 3
	ξ² Arietis ......W	......	9	50 09.09
	ε Arietis . ....W.	.....	5	58
	53 Arietis ......W.	.....	8	6 01
	Moon's I L..W.	....	9	6 12 06.67

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
Jan. 31	δ Arietis .... W.	+ 28	8	6 05
	9 Tauri .... W.	......	9	30 22.00
	17 Tauri .... W.	......	9	38 11.69
	η Tauri .... W.	....	6	40
	27 Tauri .. .... W.	......	4	42
	A¹ Tauri .... W.	......	8	58
	A² Tauri .... W.	......	9	58 41.86
	Aldebaran. .. W.	......	9	7 29 32.10
	ε Urs. Min... . W.	......	4	8 01
	Capella .... . W	......	9	08 03.11
	β Leporis...... W	......	9	23 54 54
	α Leporis....... W.	......	9	28 11.88
	α Columbæ..... W.	......	9	36 13.41
	α Aquilæ .... W.	...	9	22 45 37.50
	α Cygni .... W.	+ 49	7	23 38
Feb. 1	Sun's I L.... W.	......	6	50
	Sun's II L... W.	+ 3	6	0 01
	Venus .... .. W.	— 90	9	2 00 07.08
	β Urs. Min .... W.	— 40	9	5 52 22.48
	α Persei....... W	......	6	6 16
	17 Tauri .... W.	.....	9	38 18.50
	27 Tauri .... W.	......	8	42
	Moon's I L.. W.	— 52	9	7 11 10.89
	Aldebaran ... W.	......	8	29
[illegible]	Vega .... W.	....	9	21 33 50.87
	α Cygni .... W.	+ 20	5	23 38
2	Sun's I L.... W.	+ 20	9	03.37.47
	Sun's 10 sp'ts. W.	......		....
	Sun's II L... W.	......	9	05 53.04
	Venus .... .. W.	....	1	2 05
3	β Tauri .... W	......	3	8 19
	δ Orionis...... W.	.....	8	26
	ζ Tauri ...... W.	......	9	31 18.53
	α Columbæ .... W	......	4	36
	136 Tauri .... W.	— 90	9	46 34.96
4	Sun's I L... W.	— 48	9	11 50.68
	Sun's 11 sp'ts. W.	......		....
	Sun's II L... W	— 4	9	14 15.56
	ε Pegasi ..... W.	72	7	39
	Venus .... w.	124	9	2 14 04.34
5	Sun's I L.... W	— 31	9	16 05.70
	Sun's 7 spots. W.	......	...	....
	Sun's II L... W.	— 49	8	18 21.08
	α Ceti .... W.	— 86	7	2 54 56.95
	α Persei .... W.	......	9	6 16 40.64
	η Tauri .... W.	— 20	2	41
	μ Geminorum.. W.	— 14	8	9 16
	Sirius .... W	......	9	41 14.32
	δ Geminorum . W.	......	5	10 14
	Jupiter .... W.	......	7	16
	Jupiter's m'n. W.	.....	3	....
	Jupiter's m'n. W.	......	6	....
	Jupiter's m'n. W.	.....	6	....
	Jupiter's m'n. W.	......	6	... ...
	α² Geminorum . W.	......	9	27 58.04
	Procyon..... W.	....	9	34 14.67
	Pollux .... W.	— 15	9	39 02.61
	15 Argus....... W.	......	6	11 03
	ζ¹ Cancri ...... W.	....	8	06
	λ Cancri ...... W.	......	9	14 30.61
	θ Cancri ...... W.	— 18	9	25 54.32
	Moon's I L.. W.	......	9	28 19.05
	Moon's II L.. W.	......	9	34 46.22
	δ Cancri ...... W.	— 25	9	39 01.94
	ι Urs. Maj .... W.	......	9	51 59.23
	Vega....... W.	......	9	21 34 31.90
	α Cygni....... W.	......	3	23 38
Feb. 6	Sun's I L.... W.	......	9	0 20 16.87
	Sun's 9 spots. W.	......	....	....
	Sun's II L... W.	+ 65	7	22 31.98
	Venus's I L.. W.	— 64	9	2 23 19.00
1860.				h. m. s.
Feb. 6	ε Canis Maj ... W.	— 13	8	9 56
	δ Geminorum.. W.	......	3	10 14
	Jupiter..... .. W.	......	9	15 58.34
	Jupiter's m'n. W.	... ..	8	16
	Jupiter's m'n. W.	......	9	16 14.84
	Jupiter's m'n. W.	.....	5	16
	Castor....... W.	......	9	26 08.71
	Procyon...... W	......	9	34 27.14
	Pollux ...... W	.....	9	39 13.09
	12 Cancri ..... W.	......	4	11 03
	ζ¹ Cancri ...... W.	.....	6	06
	κ Cancri ...... W.	......	4	12 02
	ξ Leonis ...... W	....	9	26 53.52
	Moon's I L.. W.	......	8	33
	Moon's II L. W.	......	9	36 23.26
	ε Leonis ..... W	......	8	40
	Saturn .... W.	— 16	9	45 51.76
	ν Leonis ...... W.	.....	8	53
	α Leonis ..... W	......	9	13 03 24.37
	Vega ...... W.	......	1	21 34
	α Cygni .... W.	+ 16	6	23 39
8	Sun's I L.... W.	+ 51	9	0 28 37.14
	Sun's 7 spots. W	......	....	....
	Sun's II L... W	+ 56	9	30 52.14
	Venus I L... W	— 57	9	2 32 35.87
	δ Geminorum . W.	......	2	10 14
	Jupiter....... W.	.....	6	15
	Moon's II L . W	— 22	9	15 25 47.71
10	Sun's I L.... W.	— 9	7	0 36
	Sun's 4 spots. W.	......	....	....
	Sun's II L... W	— 10	5	39
	Venus I L... W.	......	7	2 41
	Venus II L.. W.	— 18	8	41
11	α Aquilæ . .... W.	— 14	7	22 47
12	Sun's I L .... W.	......	5	0 44
	Sun's 2 spots. W.	.....	....	....
	Sun's II L... W.	— 5	9	47 10.84
	Venus ...... W	......	1	2 50
	ε Canis Maj ... W.	......	9	9 56 23.44
	α¹ Geminorum . W.	......	9	10 28 57.09
	α² Geminorum . W.	......	2	28
	ζ Geminorum . W.	— 45	4	9 59
	τ Geminorum . W	......	5	10 05
	Jupiter's m'n. W	......	8	14
	Jupiter....... W	......	9	14 23.6
	Jupiter's m'n. W.	.....	5	14
	Jupiter's m'n W	.....	8	15
	α Cygni ...... W	+ 19	9	23 39 56.90
	Mercury...... W.	......	6	0 34
13	Sun's I L.... W.	......	9	48 50.06
	Sun's 4 spots. W.	.....	....	....
	Sun's II L... W.	— 22	8	51
	Venus....... W.	— 62	4	2 55
	A¹ Tauri .... W.	......	7	6 59
	A² Tauri ...... W.	......	8	7 00
	Uranus...... W.	......	2	10
	ε Can. Maj.... W.	......	9	9 56 30.68
	ζ Geminorum . W	.....	2	59
	τ Geminorum . W.	......	9	10 05 38.81
	Jupiter's m'n. W.	......	9	13 44.96
	Jupiter .. ... W.	......	9	14 11.49
	Jupiter's m'n. W.	......	9	14 16.36
	Jupiter's m'n. W.	......	9	14 17.90
	Jupiter's m'n. W.	......	9	14 29.40
	ι Geminorum . W.	......	9	20 26.03
	α¹ Geminorum . W	......	9	28 04.28
	α² Geminorum . W.	......	9	28 04.86
14	Sun's I L.... W.	......	9	0 53 00.73
	Sun's 5 spots. W.	......	....	....
	Sun's II L... W.	— 10	9	55 14.02
	Venus....... W.	— 70	9	

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
Feb. 15	Sun's I L .. W.	......	9	0 57 02.11
	Sun's II L...W.	— 64	9	59 15.01
	Venus........W.	— 77	9	3 04 27.71
16	Sun's I L....W.	......	7	1 01
	Sun's 3 spots.W.	......	...	....
	Sun's II L...W.	— 65	8	03
	Venus........W.	— 87	9	3 09 00.53
	β Tauri ....W.	......	9	8 21 14.24
	δ Orionis.......W.	— 74	8	28
17	Sun's I L ....W.	......	9	1 05
	Sun's 2 spots.W.	......	....	....
	Sun's II L...W.	— 68	2	07
	Venus...... W.	— 71	4	3 13
	δ Urs. Min ....W.	— 84	3	9 19
	μ Geminorum .W.	.....	9	18 25.86
	τ Geminorum .W.	......	9	10 06 10.69
	Jupiter, m'n .W.	......	4	12
	Jupiter, m'n .W.	......	8	12
	Jupiter, m'n .W.	......	8	13
	Jupiter, cent. W.	......	9	13 25.52
	Jupiter, m'n .W.	......	8	13
	λ Urs. Min ....W.	— 86	1	11 00
	λ Urs. Min ....W.	+ 18	2	03
	ι Urs. Maj ....W	.....	9	53 35.56
	α Cephei ....W.	.....	9	12 18 49.70
	β Cephei ....W.	......	9	30 30.79
18	Sun's I L....W.	......	7	1 09
	Sun's 5 spots.W.	......	...	....
	Sun's II L...W.	+ 35	9	11 18.93
19	Sun's I L....W.	+ 84	7	1 12
	Sun's 3 spots.W.	.....	....	....
	Sun's II L...W.	+ 64	8	15
	Jupiter I L ..W.	......	9	10 13 06.98
	Jupiter II L .W.	.....	9	13 08.78
	Jupiter, m'n..W.	......	3	13
	Jupiter, m'n..W.	......	4	13
	α² Geminorum.W.	+ 15	9	29 53.79
	α Canis Min ...W.	.....	8	36
21	Venus........W.	+ 26	9	3 31
	Polaris ....W.	+ 20	3	4 14
	Polaris...... E.	+ 29	4	07
	α Ceti..........W.	......	9	5 59 23.30
	α Persei ....W.	......	9	6 18 48.37
	S.Y.C°232...W.	......	7	30
	S.Y.C°242...W.	+ 11	9	40 58.72
Mar. 7	Sun's I L....W.	+116	9	2 18 26.64
	Sun's 5 spots.W.	.....	....	.. ..
	Sun's II L...W.	......	8	20
	Venus........W.	+125	9	4 38 40.00
	α Ceti..........W.	+ 18	1	6 00
	α Orionis.......W.	.....	9	8 53 19 87
	μ Geminorum .W.	+ 19	9	9 20 25.94
	Sirius ....W.	......	8	45
	ε Canis Maj ...W.	......	7	59
	δ Geminorum .W.	......	7	10 18
	Jupiter I L ..W.	......	8	12
	Jupiter II L .W.	......	8	12
	Jupiter, m'n..W.	......	3	12
	Jupiter, m'n..W.	.....	3	12
	Jupiter, m'n..W.	.....	3	12
	Castor........W.	......	8	31
	Procyon.....W.	+ 94	9	38 34.83
	Pollux ......W.	......	9	43 15.40
	β Leonis ......W.	.....	7	14 48
	Moon's I L ..W.	......	3	58
	Moon's II L.W.	+ 87	8	15 09
	α Aquilæ ......W.	+ 90	9	22 50 25.46
8	Sun's I L....W.	......	9	2 23
	Sun's 4 spots.W.	......	....	... .
	Sun's II L..W.	+164	9	2 25 30.93
	Mercury....W.	+136	9	3 21 00.19

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
Mar. 8	Venus I L...W	......	9	4 43 56.30
	Venus II L..W.	......	9	43 57.11
	Polaris ......W.	— 44	1	3
	α Arietis ......W.	— 64	6	5 05
	Polaris......W.	+ 16	1	3
	Aldebaran . .W.	+ 66	8	7 34
	Capella .....W.	.....	5	8 12
	Rigel ....W.	+ 67	8	14
	β Tauri.......W.	— 22	7	24
	δ Orionis .....W.	.....	9	31 27.00
	α Columbæ ...W.	......	9	41 14.98
	α Orionis .....W.	...	3	54
	Sirius...... W.	— 3	8	9 45
	a Sirius.......W.	......	3	45
	b Sirius...... W.	.....	3	45
	c Sirius.......W.	....	2	45
	ε Canis Maj...W.	.....	8	59
	δ Geminorum .W.	— 4	9	10 18 19.45
	Jupiter, m'n. W.	......	9	12 24.10
	Jupiter, m'n. W	......	9	12 30.18
	Jupiter I L..W	.....	9	12 44.19
	Jupiter II L. W	.....	9	12 47.12
	Jupiter, m'n. W.	....	9	12 55.60
	Jupiter, m'n. W.	......	9	12 58.25
	γ Urs. Maj... W.	....	9	14 53 04.81
	Polaris......W.	+ 2	2	16 12
	13 Virginius....W.	— 12	7	15 18
	η Virginius.... W.	......	8	19
	q Virginius....W.	.. .	9	33 10.92
	γ Virginius....W.	......	7	41
	Moon's II L.W.	+ 4	9	56 42.62
	θ Virginius.... W.	.....	9	16 00 19.52
	α Virginius... W.	— 13	9	24 27.11
	α Aquilæ......W.	25	9	22 50 33.32
9	β Corvi....... W.	— 26	9	15 33 40.27
	12 Can. Ven.....E.	......	9	56 00.64
	θ Virginius.....E.	......	8	16 00
	Polaris......W.	......	1	12
	Polaris.,..... E.	— 24	3	19
	α Virginius.....E	— 27	9	24 24.92
	ζ Virginius.....E.	....	6	34
	m Virginius.....E.	......	7	40
	86 Virginius.....E.	......	4	45
	89 Virginius.....E	.....	5	48
	Moon's II L..E.	— 63	9	53 54.90
	Virginius.....E.	......	9	17 12 01.67
	Arcturus......E.	— 26	8	15
	7-8 mag.comp.E.	.....	4	15
	λ Virginius.....E.	— 42	3	18
	α Aquilæ........E.	....	9	22 50 31 75
10	Sun's I L.....E.	— 9	9	2 30
	Sun's 6 spots.E	.....	...	... ...
	Sun's II L...E.	+ 50	9	33
	Mercury. .....E.	+ 20	6	3 39
	Venus ....E.	— 11	9	4 52
	Jupiter ......E.	......	9	10 12 40 77
	δ Geminorum ..E.	— 8	8	18
	Arcturus.....E.	.....	2	17 15
	ε Bootis . .. E.	......	3	45
	Moon's II L..E.	— 17	9	52 42.83
	α Cygni.........E	— 16	9	20 43 18 64
11	δ Geminorum ..E	.....	9	10 18 25.27
	Jupiter I L...E.	— 19	9	10 12
	Jupiter II L..E	......	9	12
	Jupiter, m'n E.	......	9	12
	Jupiter, m'n..E.	......	6	12
	Jupiter, m'n..E.	......	9	12
	β Urs. Min.....E.	— 24	8	17 57
	ι Libræ . ...E.	......	8	18 11
	β Libræ . ...E.	......	8	16
	ξ² Libræ . ...E.	......	9	27 16.42

Transit observations—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
Mar. 11	α Cor. Bor.…. E.	— 34	9	18 35 38.01
	α Serpentis …. E.	— 26	9	44 15.88
	Moon's II L.. E.	……	9	52 48.54
	δ Scorpii ……. E.	……	9	58 57.88
	β¹ Scorpii ……. E.	— 32	6	19 04
	σ Scorpii ……. E.	……	9	19 35.81
	α Scorpii ……. E.	…..	9	27 44.36
	τ Scorpii ……. E.	— 34	9	34 04.82
	α Aquilæ ……. E.	37	9	22 50 50.77
	α Cygni ……… E.	35	….	23 43 28.54
12	Sun's I L.…. E.	— 3	9	2 38
	Sun's 5 spots. E.	……	…	…………
	Sun's II L.… E.	+ 48	9	40
	Polaris……. E.	……	1	3 11 53.4
	Polaris…… E.	+ 18	2	27 31.1
	Polaris…… E.	+ 47	3	43 09.2
	Polaris……. E.	— 10	4	59 56.0
	Polaris……. E.	67	5	4 15 45.9
	Polaris……. E.	86	6	31 47.6
	Polaris……. E.	97	7	47 48.5
	Polaris…… E	104	8	5 03 32.6
	Polaris…… W.	— 9	1	2 19 06.2
	Polaris…… W.	+ 18	2	34 20.1
	Polaris…… W.	+ 13	3	50 09.0
	Polaris…… W.	— 49	4	4 07 00.2
	Polaris…… W.	85	5	23 11.0
	Polaris….. W.	96	6	38 35.7
	Polaris…… W.	107	7	54 26.6
	Polaris…… W.	104	8	5 10 54.2
	Polaris…… W.	—113	9	26
	ε Canis Maj .. W.	+ 21	9	10 00 03.99
	δ Geminorum.. W.	….	7	18
	Jupiter I L.. W.	+ 24	8	13
	Jupiter II L. W.	…..	7	13
	Jupiter, m'n. W.	……	9	13
	Jupiter, m'n. W.	……	6	13
	Jupiter, m'n. W.	…..	7	13
	α Scorpii . …. W.	+ 6	4	19 27
	Moon's II L. W.	+ 9	9	53 16.31
	η Ophiuchi … W.	……	9	20 09 23.78
	A Ophiuchi…. W.	……	7	13 46.0
	ξ Ophiuchi … W.	……	5	19
	θ Ophiuchi…. W.	……	4	20
	Ophiuchi…. W.	……	2	20
	b Ophiuchi…. W.	…..	8	24
	c² Ophiuchi…. W.	+ 8	8	29
	Mars……. W.	……	9	43 59.86
	Vega ……. W.	— 1	9	21 39 21.71
	α Aquilæ . …. W.	2	9	22 51 02.09
	α Cygni . ….. W	— 3	9	23 43 51.42
13	Sun's I L… W.	+ 20	9	2 42
	Sun's 2 spots. W.	……	….	…………
	Sun's II L.. W.	25	9	44
	Mercury….. W.	21	4	3 46
	α Cygni ……… E.	+ 8	5	23 43
16	α Aquilæ …. . E.	— 1	9	22 51 45.27
	α Cygni ……… E.	— 7	8	23 44
19	Sun's I L…. E.	+ 18	9	3 04
	Sun's 2 spots. E.	……	….	…………
	Sun's II L… E.	+ 37	9	06
	Venus ……… E	+ 12	9	5 34
21	Sun's I L…. E.	……	9	3 12
	Sun's 3 spots. E.	……	…	…………
	Sun's II L… E.	+ 50	9	14
	Jupiter's m'n. E.	……	7	10 14
	Jupiter's m'n. E.	……	9	15
	Jupiter's m'n. E.	……	9	15
	Jupiter's I L.. E.	……	9	15
1860.				h. m. s.
Mar. 21	Jupiter's II L. E.	……	8	15
	δ Geminorum.. E.	+ 19	4	20
	α Aquilæ ……. E.	— 7	8	22 52
22	Sun's I L…. E.	+ 17	9	3 16
	Sun's 4 spots. E.	……	….	…………
	Sun's II L… E.	+ 41	9	3 18
	Venus……. W.	……	9	5 48
	Polaris ….. E.	+ 24	2	3 29 23.4
	Polaris….. W.	13	….	36 32.0
	α Cassiopeæ… W.	12	4	41
	Polaris…… W.	23	3	52 00.0
	Polaris……. E	22	4	4 01 03.9
	Polaris……. E.	+ 14	5	16 32.1
	Polaris……. E.	……	6	32 18.6
	Polaris…… W.	+ 14	6	39 11.7
	Polaris……. E.	18	7	48 08.7
	Polaris…… W.	+ 14	7	54 47.3
	Polaris……. E.	+ 18	8	5 03 35.4
	Polaris…… W.	— 4	8	11 02.6
	Polaris……. E.	+ 2	9	19 27.1
	Polaris …… W.	+ 15	9	26 46.7
	Jupiter's m'n W.	……	2	10 15
	Jupiter's I L. W.	……	7	15
	Jupiter's II L. W.	…..	6	15
	δ Geminorum . W.	+ 13	8	20
24	Sun's I L. .. W.	5	9	3 23
	Sun's 2 spots W.	…..	…	…………
	Sun's II L… W.	+ 28	9	3 25
	Capella ….. W.	…..	2	8 15
	Rigel…….. W.	+ 13	8	16
	β Tauri……. W.	……	9	26 18.82
	δ Orionis . …. W.	……	9	33 38.86
	α Leporis…. W.	……	4	35
	ε Orionis . …. W.	+ 16	3	37
	α Orionis . …. W.	……	9	56 24.38
	μ Geminorum . W.	……	9	9 23 21.38
	Sirius……. W.	+ 14	9	47 45.07
	W.	…..	2	47
	ε Canis Maj… W.	……	9	10 01 52.67
	δ Geminorum.. W.	+ 21	9	20 38.06
	Castor ….. W.	……	9	34 34.59
	Procyon….. W.	……	9	40 48.40
	W.	…..	4	41
	Pollux …… W.	+ 23	6	45
	α Hydræ. …. W.	— 20	8	12 29
	Saturn's R. I. W.	……	9	30
	Saturn's R. II W.	……	9	30
	ε Leonis…… W.	…..	9	46 48.70
	α Aquilæ ….. W.	— 7	9	22 52 51.40
	α Cygni……. W.	— 14	9	23 45 41.51
	Polaris……. E	+ 6	1	3 14 16.5
	Polaris ….. W.	+ 5	1	21 47.8
25	Sun's I L…. W.	……	9	3 27
	Sun's 3 spots W.	….	….	…………
	Sun's II L.. W.	+ 16	9	3 29
	Polaris…… W.	……	2	37 27.8
	α Cassiopeæ… W.	…..	4	41
	Polaris…… W.	+ 14	3	52 54.0
	Polaris……. E.	17	4	4 01 24.7
	Polaris……. E.	17	5	16 57.8
	Polaris…… W.	15	5	24 18.7
	Polaris……. E.	19	6	32 39.8
	Polaris…… W.	16	6	39 54.9
	Polaris…… E.	13	7	48 39.7
	Polaris …… W.	+ 12	7	55 28.2
	α Arietis…… W.	— 3	3	5 08
	Moon's I L.. W.	+ 10	8	43
	Venus …… W.	+ 12	9	6 08 44.17

TRANSIT OBSERVATIONS IN THE PRIME VERTICAL.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1860. Feb. 22	Jupiter....E.,N.	+111	9	5 44 38.91
	Pollux....E.,N.	109	9	6 40 49.79
	Capella...E.,N.	+107	8	58 42.40
	Saturn....E.,N.	......	9	7 42 42.89
	Regulus ..E.,N.	+116	9	53 17.11
	ε Leonis... E.,N	......	8	8 21 31.28
	Capella ..W.,N.	+ 97	9	9 23 05.50
	β Leonis....E.,N.	+ 96	9	45 11.13
	9 Tauri ....W.,N.	......	5	11 02 14.76
	17 Tauri ....W.,N.	......	6	05 39.25
	23 Tauri ....W.,N.	+ 87	9	07 53.23
	ι Aurigæ...W.,N.	− 19	9	25 33.77
	Uranus...W.,N.	......	4	49 24.75
	η Bootis ....E.,N.	− 18	9	12 07 03.38
	β Tauri ....W.,N.	......	9	21 49.04
	Arcturus..E.,N.	......	9	31 52.08
	Arcturus..W.,N.	− 31	6	21 54 48.28
	α Cygni.. ..E.,N.	− 26	6	22 06 12.23
	α Cor. Bor..W.,N	......	1	40 14.5
	Vega ....W.,N.	− 53	9	0 26 36.88
	α Cygni ....W.,N.	54	9	1 16 37.43
23	Aldebaran E.,N.	54	5	2 34 45.56
	β Tauri .... E.,N.	− 57	4	4 22 12.10
	Jupt. I L..E.,N.	......	9	5 44 24.86
	Jupt. II L E.,N.	......	9	44 28.78
	Pollux ....E.,N.	......	9	6 40 49.78
	Capella...E.,N.	− 51	9	58 27.56
	Saturn ....E.,N.	......	9	7 42 34.22
	Regulus...E.,N.	− 28	8	53 17.10
	λ Leonis...E.,N.	......	8	8 03 20.24
	ε Leonis....E.,N.	......	5	21 33.08
	Capella...W.,E.	− 30	9	9 23 26.66
	β Leonis....E.,N.	− 36	8	9 45 13.33
	ι Aurigæ...W.,N.	− 37	8	11 25 40.38
	Uranus...W.,N.	......	8	49 33.83
	β Tauri ....W.,N.	− 37	9	12 21 55 99
	Aldebaran W.,N.	......	5	30 14.54
	Arcturus..E.,N.	− 43	6	31 57.85
	Arcturus .W.,N.	63	9	21 55 54.94
	α Cygni ... E.,N.	58	9	22 06 15.55
	Vega ....W., N.	67	9	0 26 43.92
	α Cygni ....W.,N.	76	9	1 16 19.74
24	Aldebaran E.,N.	+ 5	9	2 34 53.59
	β Tauri.....E.,N.	− 5	9	4 22 20.62
	Jupiter E. I ..N.	+ 9	9	5 44 22.18
	Jupiter E. II .N.	......	9	44 26.31
	Pollux.... E.,N.	+ 3	9	6 40 58.18
	Castor....E.,N.	+ 8	8	52 26.69
	Capella...E.,N.	......	7	58 42.69
	α Andromedæ .N.	......	5	7 06 36.96
	α Pegasi........N.	+ 15	1	07 26.6
	Saturn.....E.,N	20	8	42 30.53
	Regulus...E.,N.	+ 20	9	53 26.99
	λ Leonis....E.,N	......	9	9 03 29.31
	γ Pegasi ...W.,N.	+ 21	9	15 54.97
	ε Leonis ...E.,N.	+ 24	9	21 41.83
	Mn's I L..W.N.	....	6	9 06 37.13
	Mn's II L W.N	.....	9	09 16.96
	Capella ..W.,N.	......	9	23 26.8
	α Arietis ...W.,N.	+ 28	7	32 43.83
	β Leonis ...E.,N.	28	8	45 21.30
	ι Aurigæ ..W.,N.	+ 19	8	11 25 46.60
	Uranus...W.,N.	...	5	49 42.94
	η Bootis .. ..E.,N.	+ 18	8	12 07 17.21
	β Tauri ....W.,N.	+ 28	9	22 02.34
	Aldebaran W.,N.	......	6	30 21.13
	Arcturus..E.,N.	......	4	32 06.30
25	Pollux ...E.,N.	+ 1	5	6 41 05.02
	Capella...E.,N.	.....	5	58 12.2
	Castor ....E.,N.	......	4	52 31.75

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1860. Feb. 25	α Androm..W.,N.	− 4	2	7 06 41.9
	α Cygni....W.,N.	+ 4	5	21 16 29.46
26	Vega ..W.,N.	+ 13	9	0 27 02.31
	Mn's I L..E.,N.	..	9	1 08 47.90
	α Cygni ..W.,N.	+ 15	7	16 34.5
	Aldebaran E.,N.	23	9	2 35 14.48
27	β Tauri .....E.,N.	24	9	4 22 41.30
	Jupiter I..E.,N.	+ 31	8	5 44 13.90
	Jupiter II.E.,N.	....	8	44 18.06
	Pollux....E.,N.	+ 28	9	6 41 19.29
	Castor....E.,N.	.....	6	58 47 75
	Capella ...E.,N.	......	5	09 06.06
	Androm..W.,N.	......	6	7 06 56.88
	α Pegasi ...W.,N.	+ 39	3	07 49 4
	Saturn I...E.,N.	+ 44	9	42 16.42
	Saturn II..E.,N	......	9	42 18.94
	Saturn m'n E.,N.	......	4	42 01.07
	Regulus...E.,N.	......	9	53 48.58
	λ Leonis....E.,N.	+ 48	9	8 03 50.34
			9	
	γ Pegasi ...W.,N.	22		16 14.84
	ε Leonis ...E.,N.	13	8	22 02.50
	Capella ..W.,N.	+ 24	7	9 23 48.06
	Venus....W.,N	......	3	38 56.57
	β Leonis.... E.,N.	+ 32	9	45 42.50
	Mn's I L. W.,N.	+ 21	9	10 35 04.58
	Mn's II L.W.,N.	......	9	38 14.35
	ι Aurigæ ...W.,S.	+ 41	9	11 26 07.78
	Uranus...W.,S.	− 4	8	50 12.86
	Castor ....W.,S	4	5	14 08 47.14
	α Cor. Bor ..E.,S.	− 7	6	26 57.12
	Jupit I. ..W.,S.	....	8	40 13.36
	Jupit. II ..W.,S.	......	8	40 17.71
	Jupit. m'n W.,S.	....	8	40 21.51
	Jupit. m'n W.,S.	......	8	40 23.53
	Jupit. m'n W.,S.	......	8	40 29.63
	Jupit. m'n W.,S.	.....	8	40 36.90
	Arcturus..W.,S.	− 7	8	21 56 22.73
	Venus' sun E.,S.	4	9	22 23 37.80
Mar. 3	Aldebaran.E.,S	16	2	2 35 58.7
	β Tauri .....E.,S.	14	3	4 22 19.13
	Mn's I L. E.,S	− 25	8	6 21 08.34
	Jupiter's I.E.,S.	.. ..	9	5 44 16.78
	Jupiter's II E.,S.	− 7	9	44 28.50
	Pollux ....E.,S.	+ 9	9	6 41 57.42
	Capella ...E.,S.	4	8	59 37.14
	Saturn.... E.,S.	+ 10	9	7 41 58.48
	Regulus ...E.,S.	.....	7	54 26.90
	Arcturus..W.,S.	+ 4	9	21 57 03.46
	α Cygni .....E.,S.	+ 1	7	22 07 27.46
4	Pollux ....E.,S.	− 1	8	6 42 05.40
	Castor .....E.,S.	......	7	53 22.21
	Mn's I L..E.,S.	......	9	7 01 38.32
	Mn's II L..E.,S.	.....	9	04 56.36
	Saturn .... E.,S.	+ 8	4	41 55.72
	Regulus....E.,S.	.....	9	54 34.38
	λ Leonis....E.,S.	+ 7	9	8 04 28.62
	γ Pegasi.....W.,S.	.....	5	17 02.19
	ε Leonis....E.,S.	+ 6	6	22 48.37
	Capella...W.,S.	..	4	9 24 42 5
	α Arietis ... W.S	− 7	9	33 53.78
	β Leonis ....E.,S	+ 1	8	46 29.26
	η Tauri.....W.,S.	+ 21	9	11 09 28.12
	ι Aurigæ ...W.,S.	......	9	26 36.17
	Uranus ...W.,S.	+ 16	6	51 58.88
	η Bootis ....E.,S.	12	9	12 08 24.38
	β Tauri ...W.,S.	+ 8	9	23 11.59
	Aldebaran W.,S.	......	5	31 31.19
	Arcturus ..E.,S.	......	4	33 14.88
	Arcturus..W.,S	− 1	9	21 57 11.80

Transit observations in the prime vertical—Continued.

BITTER ROOT.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.	1860				h. m. s.
Mar. 5	Capella...W.,S.	......	4	9 24 49.5	Mar. 5	ι Aurigæ ...W.,S	......	1	11 27 04.6
	α Arietis....W.,S.	+ 2	8	34 01.46		Arcturus.. E.,S.	......	2	12 33 24.55
	Leonis E.,S	+ 3	8	9 46 37.29		Vega ....W.,S.	......	1	0 28 13.8
	Venus I L.W.,S	+ 3	9	57 06.76		α Cygni ....W.,S	....	2	1 17 48.7
	Venus II L W.S.	.....	9	57 08.33	6	α Cygni ....W.,S.	....	1	1 17 54.0
	η Tauri ... W.,S.	......	1	11 09 45.5					

TRANSIT OBSERVATIONS.

HELL GATE.

Mar. 31	Moon's I L...W.	+125	9	11 40 00.63	April 6	86 Virginis.....W.	......	8	45
	α Cygni.......W.	+ 99	8	23 43		89 Virginis.....W	......	8	16 49
April 1	Sun's I L....W.	+112	1	3 53		η Bootis.......W.	+ 2	9	55 03.44
	Sun's II L...W.	+130	7	55	7	β Urs. Min....W.	......	9	17 58 45.36
	α Persei.......W.	+104	4	6 20		ι¹ Libræ........W.	+ 10	8	18 11
	Venus ..... W.	+124	9	34 40.90		Moon's II L.W.	....	9	23 36.56
						α Cor. Bor ... W	+ 6	9	35 57.22
	Capella ......W.	.....	4	8 12		α Serpentis....W.	.....	9	44 32.69
	Rigel.........W.	+ 5	3	16	8	Sun's I L...W.	+ 1	9	4 16
	β Tauri.......W	......	9	23 41.07		5 Spots.....	.....	..	....
	δ Orionis .....W.	.....	7	31		Sun's II L..W	+ 30	9	19
	ε Orionis.....W	+ 6	4	35		α Serpentis ...W.	.....	6	18 44
	α Orionis......W.	......	9	53 48.50		δ Scorpii......W.	......	7	59
	Sirius........W.	.....	1	9 45		β¹ Scorpii .....W.	......	7	19 04
	ε Canis Maj...W.	......	4	50		δ Ophiuchi....W.	+ 19	4	14
	Castor.......W.	......	9	10 31 56.21		σ Scorpii.....W.	......	1	20
	Procyon.....W.	.....	9	38 12.56		Moon's II L.W	......	8	25
	Pollux ......W.	+ 11	4	43		α Scorpii......W.	......	4	28
	15 Argus.......W.	......	9	11 07 48.27		τ Scorpii......W.	+ 21	7	34
	ι Urs. Maj ....W.	......	9	55 57.43		ε Urs. Min....W	+ 19	9	20 08 41.22
	κ Cancri.......W.	+ 20	9	12 06 25.28		β Draconis....W.	.....	9	34 42.04
	63 Cancri.......W	+ 11	9	17 26.21		Polaris ....E	+ 32	2	4 19
	α Hydræ.......W.	.....	6	26		Polaris ....W.	+ 32	2	19
	ξ Leonis.......W.	......	5	30	9	Sun's I L....E.	+ 42	7	4 20
	Moon's I L..W.	.....	9	35 53.27		Sun's 6 Spots...	....	....	... .
	ε Leonis.......W.	+ 19	9	44 11.42		Sun's II L....E.	+ 63	7	22
	α Leonis.......W.	......	9	13 07 11.58		β Urs. Min ....W.	+ 42	4	5 57
	γ Leonis.......W.	......	8	12 56		Capella ....E.	+ 62	9	8 13
2	Sun's I L....W.	......	9	3 54		β Tauri....... E.	— 6	2	24
	Sun's 3 Spot	......	....	....		Jupiter's I L.E	......	8	10 19
	Sun's II L...W.	+ 42	9	56		Jupiter's II L.E.	...	8	19
3	Sun's I L.....N	.....	3	3 57		Castor........E.	......	7	10 32
	Sun's II L ...N.	+ 78	7	4 00		Procyon.......E.	.....	9	39
	Capella ....N.	......	5	8 12		Pollux.........E	— 7	7	44
	Rigel ....N.	+ 40	7	14	10	Sun's I L . E.	— 17	8	4 24
5	Capella ......W.	......	5	8 13		Sun's 4 Spots ...	......	....	....
	Rigel.........W.	+ 73	7	14		Sun's II L...E	+ 9	3	26
						Jupiter.......E.	.....	2	10 29
	β Tauri.......W.	— 2	8	24		Castor....... E.	......	9	33
	δ Orionis......W.	.....	9	31 26.08		Procyon .....E.	......	9	39
	ε Orionis .....W.	— 8	6	35		Pollux ....E.	— 36	9	44
	Polaris.......W.	— 16	2	16 08		θ Urs. Maj.....E.	......	7	12 30
	β Corvi ....W.	......	9	15 33 53 64		Saturn —— ..E.	....	9	35
	γ Virginis... .W.	......	9	41 26.16		Saturn —— ..E.	....	9	35
	ψ Virginis. ...W.	......	9	53 56.91		ε Leonis.......E.	— 4	9	45
	θ Virginis.....W.	— 2	9	16 09 34.50		T. Y. C.* 1548.E.	+ 10	7	21 00
	Moon's I L.					γ Sagittarii.....E.	.....	8	05
	imperfect..W.	......	9	21		μ¹ Sagittarii.....E.	......	9	12 55.81
	Moon's II L.					δ Sagittarii. .. E.	.....	9	19 33.50
	perfect....W.	......	9	23 36.72		Moon's II L..E.	+ 2	9	27 33.67
	α Virginis.....W.	......	1	24		Vega ....E.	......	9	39 43 60
	ζ Virginis. ...W	.....	9	34 26.67		φ Sagittarii.....E.	....	9	41 26.57
	m Virginis.....W.	......	9	41 08.57		Mars.........E.	.....	9	51 38.34
	86 Virginis.... W.	......	8	45		σ Sagittarii.... E.	... ..	5	54
	89 Virginis.....W.	— 6	8	49		ζ Sagittarii.....E.	+ 4	9	22 01 14.28
6	Sun's I L...W.	— 1	8	4 09		τ Sagittarii.....E.	.....	1	05
	Sun's 4 Spots ...	......	....	....		α Aquilæ ......E.	+ 3	9	22 51 29.67
	Sun's II L...W.	+ 1	9	11 26.66		α Cygni........E.	— 7	9	23 44 10.89
	Jupiter .....W.	......	4	10 18		Polaris........E.	+20.4	9	4 12 13.54
	Polaris......W.	......	1	16 08		Polaris ......W.	+13.1	9	18 55.14

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Transit observations—Continued.

HELL GATE.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.		
				h.	m.	s.
1860. Apr. 11	Sun's I L.....E.	......	1	4	28	
	Sun's II L...E.	......	8		30	
	Venus, II L. W.	+ 19	9	7	20	
	Aldebaran ...W.	+ 21	8		35	
	Capella ......W.	....	4	8	14	
	Rigel . ...W.	+ 20	8		15	
	Sirius........W.	+ 20	9	9	46	
	ε Canis Maj...W.	+ 20	5	10	00	
	δ Geminorum .W.	......	1		19	
	Jupiter, I ...W.	.....	9		20	
	Jupiter, II...W.	+ 17	9		20	
	Castor ......W.	....	9		33	
	Procyon .....W.	......	9		39	
	Pollux ....W.	+ 17	9		44	
	α Cephei .....W.	+ 22	8	12	22	
	θ Urs. Maj ....W.	......	9		31	
	Saturn's I...W.	.....	9		35	
	Ring II ......W.	......	9		36	
	ε Leonis.......W.	+ 18	9		45	
	Vega ....W.	......	9	21	40	06.86
	φ Sagittarii... W.	......	9		44	47.70
	Mars ....W.	.....	1		54	
	σ Sagittarii....W.	+ 5	7		54	
	ζ Sagittarii....W.	......	7	22	01	
	τ Sagittarii....W.	+ 4	5		06	
	Moon's II L. W	+ 5	9		24	27.29
	α Aquilæ.......W.	+ 5	9		51	50.41
	α Cygni........W.	+ 10	9	23	44	35.63
12	δ Sagittarii ?...W.	.....	5	21	28	
	Vega.........W.	− 22	8		41	
	α Aquilæ . .....W.	− 25	9	22	56	
	Moon's II L	− 36	9	23	24	
	α Cygni	− 37	9		45	
24	Polaris.......W.	− 60	2	4	18	
	Polaris........E.	− 40	1		12	
	Sun's I L.....E.	......	2	5	18	
	Sun's 4 Spots...	......	....	....	....	....
	Sun's II L ...E.	− 20	9		20	
	Aldebaran....E.	+ 36	8	7	37	
	Capella ....E.	+ 17	3	8	16	
	Moon's I L ..E.	......	9		18	21.52
	Venus ....E	......	9		23	46.60
	β Tauri ....E.	......	7		27	
	δ Orionis ....E	......	9		34	40.77
	ε Orionis ....E.	+ 9	7		38	
	α Orionis ....E.	+ 20	5		57	
	Sirius . ...E.	+ 83	9	9	46	
	ε Can. Maj ....E.	+ 69	8	10	02	
	Jupiter, I ....E.	......	9		29	
	Jupiter, II ...E.	+ 71	9		29	
	Castor.........E.	......	8		35	
	Procyon.......E	...	9		41	
	Pollux ....E	+ 66	9		46	
26	Capella.......W.	+ 20	4	8	16	
	Rigel ....W.	+ 18	8		18	
	β Tauri.........W.	......	5		27	
	Venus ....W	......	9		33	
	ε Orionis.......W.	+ 30	7		39	
	α Orionis ......W.	......	9		57	
	Sirius ....W.	+ 6	9	9	49	
May 1	Sirius . ...W.	+ 33	9	9	49	
	θ Urs. Maj ....W.	+ 32	3	12	34	
	Saturn ....W.	+ 26	9		39	
	ε Leonis ...... W.	+ 32	9		49	
	Regulus.......W.	+ 31	9	13	11	59.88
	δ Leonis ....W.	......	9		17	
	ι Leonis ....W.	+ 32	8		27	
2	Aldebaran . .W.	− 3	2	7	39	
	Sirius ....W.	+ 42	9	9	50	
	ε Canis Maj. ..W	......	9	10	04	
	Jupiter I .....W.	......	9		35	
	Jupiter II.....W.	......	9	10	35	
1860. May 2	Castor .. ....W.	......	2		37	
	Procyon .. ..W.	..	9		43	
	Pollux .. ....W.	+ 50	9		48	
	ι Urs. Maj.. ..W.	39	3	12	01	
	α Cephei ....W.	+ 5	9		56	
	β Cephei . .....W.	......	5		37	
	Saturn .... ..W.	.....	9		40	
	ε Leonis ......W.	+ 3	9		49	
	Regulus ......W.	− 4	9	13	12	11.70
	δ Hydræ ..... W.	− 6	7	14	23	
	γ Cephei ... ..W.	.....	3		44	
	γ Urs. Maj......W.	....	9		57	
	13 Virginis . .....E.	......	9	15	22	37.47
	η Virginis . .....E.	− 4	9		23	58.33
	ρ Virginis . ... E.	......	6		37	
	β Corvi .... E.	.....	4		38	
	γ Virginis . .....E.	− 5	7		45	
	Moon's I L...E.	......	9		58	09.22
	δ Virginis . .....E.	+ 3	3		59	
	θ Virginis . .....E.	− 3	9	16	13	40.50
	Polaris ....W.	− 5	1		11	
	Polaris .. ..E.	+ 2	1		18	
	α Virginis . .. .E	− 2	9		26	36.36
	ζ Virginis . .....E.	......	9		38	41.96
	m Virginis . .....E.	......	9		45	23.68
	86 Virginis . .....E.	......	9		49	36.42
	89 Virginis . ... E.	− 5	8		53	
	Polaris .. ..E.	16	4	4	04	06.2
	Polaris ....W.	29	4		09	46.2
	Polaris ....W.	− 12	5		25	03.5
	Polaris .. ..E.	+ 27	6		33	30.2
	Polaris ....W.	11	6		40	08.1
	Polaris ....W.	5	7		55	56.7
	Polaris ....W.	+ 56	9	5	26	54.4
	Mercury ......W.	......	9	4	16	46.64
3	Sun's I L.....W.	+ 43	8	5	55	00.00
	Sun's 7 spots.W.	......	....	....	....	......
	Sun's II L....W.	+ 60	9		57	
	Aldebaran . .W.	15	3	7	30	
	Capella . .....W.	+ 23	4	8	17	
	Rigel . ...W.	......	9		19	10.98
	Venus.........W.	+ 60	9	9	06	
	ε Canis Maj. ..W.	+ 62	4	10	04	
	Jupiter I.....W.	......	9		35	
	Jupiter II.....W.	......	9		35	
	Castor .. ..W.	......	2		37	
	Procyon .. ..W.	......	9		43	
	Pollux .. ..W.	+ 69	9		48	
	Merc'y sun...W.	18	3	4	23	
	Polaris ....W.	39	6		40	13.3
	Polaris .. ..E.	41	7		49	42.7
	Polaris .. .... E.	66	8	5	04	48.5
5	Polaris .. ..E	24	7	4	49	58.9
	Polaris ....W.	16	7		56	12.2
	Polaris .. ..E	21	8	5	05	22.3
	Polaris ....W.	16	8		12	00.4
	Polaris .. ..E	25	9		21	06.6
	Polaris ....W.	16	9		27	56.0
6	Sun's I L.....W.	+ 22	9	6	06	
	Sun's 7 spots.W.	......	...	......	......	......
	Sun's II L....W.	+ 58	9		08	
	α Cephei . .....W.	+ 56	4	12	26	
	β Cephei . .....W.	....	5		38	
	Saturn.........W.	+ 57	9		41	
	ε Leonis ....W.	52	9		49	55.44
	Regulus ....W.	+ 45	9	13	12	55.47
	γ¹ Leonis ....W.	......	9		24	17.57
	ε Pegasi........W.	− 40	5	0	49	
	Polaris .. ..E.	23	1	3	16	30.3
	Polaris ....W.	27	1		23	11.4

Transit observations—Continued.

HELL GATE.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1860. May 6	Polaris .. ....E.	14	2	3 32 14.5
	Polaris ......W.	25	2	38 59.2
	Polaris .. ....E.	19	3	48 28.6
	Polaris ......W.	26	3	54 31.2
	Polaris .. ....E.	16	4	4 04 02.2
	Polaris ......W.	26	4	10 37.4
	Polaris .. ....E.	13	5	19 36.0
	Polaris ......W.	16	5	26 16.2
	Polaris .. ....E.	— 18	6	34 52.8
	Mercury .....E.	......	8	37
				h. m. s.
1860. May 6	Polaris ......W.	+ 12	6	4 40 50.6
	Polaris .. ....E.	+ 13	8	5 06 10.9
	α Arietis ......W.	.....	6	11
	Polaris ......W.	+ 17	9	28 26.5
	β Urs. Min.. ..W.	24	5	6 02 36.8
	Sun's I L....W.	+ 20	4	11
8	Capella . ....W.	— 11	9	8 18
9	Sun's I L ...W	— 18	9	6 18
	Sun's 5 spots.W.	.....	....	....
	Sun's II L...W.	+ 6	9	20

PRIME VERTICAL OBSERVATIONS.

Apr. 12	Pollux ... E.,N.	+ 16	9	6 45 51.36
	Capella . ..E.,N.	25	8	7 13 24.84
	Capella...W.,N.	+ 35	8	9 14 25.89
	Sun I ....W.,N.	......	9	57 59.45
	Sun II....W.,N.	+ 47	9	10 00 58.47
	Aldebaran.W.,N.	......	8	12 32 13.14
	Arcturus ..E.,N.	+ 49	5	36 16.86
	136 Tauri ....W.,N.	.....	5	55
	Venus.....E.,N.	— 12	9	3 08
	Jupiter . ..E.,N.	— 4	8	5 55
13	Capella...W.,N.	+ 19	8	9 15 27.9
	Sun's I L..W.,N.	......	8	10 01
	3 spots	......	..	....
	Sun's II..W.,N.	+ 64	9	04
	Venus....W.,N	+ 19	7	11 52
	η Bootis .. ..E.,N.	......	8	12 12
	β Tauri ....W.,N.	......	9	23 49.13
	Arcturus ..E ,N.	+ 27	5	37
	Aldebaran.W.,N.	.....	9	33
	Castor ....W.,N.	+ 22	5	14 09
	α Cor. Bor...E.,N.	+ 20	8	32 30.76
	Pollux....W.,N.	......	9	44
	Jupiter ...W.,N.	......	4	48
	Sun's I....E.,N.	......	9	23 15
	5 spots	......	....	....
	Sun's II...E.,N.	— 43	9	18
	Venus ....E.,N.	+ 21	9	3 14
	Jupiter ....E.,N.	+ 18	8	5 55
14	Sun's I ...W.,N.	......	9	10 03
	Sun's 5 spots....	......	...	....
	Sun's II..W.,N.	+ 80	9	06
	Sun's I L..E ,N.	......	9	23 20
	Sun's 2 spots ...	......	....	....
	Sun's II...E.,N.	— 8	9	23
	α Cygni....W.,N.	+ 26	4	1 12 00.1
15	Capella ..W.,N.	+ 5	3	9 15 53.1
	Sun's I...W.,N.	......	9	10 06
	Sun's 3 spots ...	......	...	....
	Sun's II..W.,N.	+ 23	9	09
	Venus....W.,N.	+ 10	9	12 00
	β Tauri.....W.,N.	......	9	24 10.6
	Aldebaran.W.,N.	......	9	33
	Arcturus ..E.,N.	— 1	6	37
	12 Can. Ven. E.,N.	+ 6	9	13 16 34.25
	1 Geminor..W.,N.	......	4	29
	49 Aurigæ....W.,N.	......	4	35
	μ Geminor..W ,N.	......	8	51
	ε Bootis ....E.,N.	......	9	45
	ε Geminor..W.,N.	+ 8	9	59
	Castor....W.,N.	......	5	14 10
	Arcturus..W.,N.	. ....	5	21 59
	α Cygni......E.,N.	— 24	7	22 19 11.1
	α Cor. Bor..W.,N.	......	5	42 49.0
	Sun's I L.,E.,N.	......	9	23 26
	Sun's spots.	......	....	....
	Sun's II L.E.,N.	— 76	9	28
	Vega.....W.,N.	— 29	9	0 27 12.2
Apr. 15	α Cygni....W.,N.	— 27	6	1 12 09.7
	Venus.....E ,N.	— 9	9	3 26
16	β Tauri. ....E.,N.	......	1	4 29
	Jupiter....E ,N.	— 2	9	5 56
	Capella....E.,N.	.....	1	7 14 50.30
	Capella ..W.,N.	+ 51	6	9 15 55.05
	Sun's I L..W.,N.	.....	9	10 08
	Sun's 2 spots....	......	....	....
	Sun's II..W.,N.	+ 75	9	11
	Venus ....W.,N.	+ 37	9	12 04
	β Tauri ....W.,N.	......	9	24 15.8
	Aldebaran.W ,N.	......	9	33
	Arcturus..E.,N.	+ 92	5	37
	12 Can. Ven..W.,N.	......	8	13 19
	1 Geminor..W.,N.	......	8	22
	ε Aurigæ....W.,N.	.....	6	38
	ε Bootis.....E.,N.	+100	2	48
	Sun's I L..E.,N.	......	8	23 34
	Sun's 3 spots ...	......	....	....
	Sun's II L,..E.N.	+ 62	9	36
	Vega......	......	4	0 30
17	Sun's I L.W.,N.	......	6	10 11
	Sun's 3 spots ...	......	....	....
	Sun's II L.W.,N.	......	4	13
18	Sun's I L.W.,N.	......	8	10 14
	Sun's 4 spots....		....	....
	Sun's II L.W.,N.	+ 20	9	17
	Venus.... W.,N.	+ 23	9	12 12
	β Tauri.... W.,N.	......	5	25
	Aldebaran.W.,N	.....	9	34
	Arcturus. W.,N.	+ 29	5	38
	130 Tauri....W.,N.	+ 39	8	57
	ε Aurigæ...W.,N.	......	4	13 08
	12 Can. Ven..E.,N.	......	9	17
	α Cor. Bor..W.,N.	— 21	5	22 44
	Sun's I L..E.,N.	— 31	6	23 44
	Sun's 3 spots ...	......	....	....
	Sun's II L..E ,N.	......	9	47
	Vega .....W.,N.	— 6	9	0 28 14.0
	Venus.....E.,N	+ 20	8	3 44
19	Sun's I L.W.,N	......	9	10 16
	Sun's 3 spots ...	......	....	....
	Sun's II L.W.,N.	+ 46	8	19
	Venus....W.,N.	+ 27	9	12 16
	β Tauri....W.,N.	.....	5	25
	Aldebaran.W.,N.	......	9	34
	Arcturus..E.,N.	+ 24	5	38
	136 Tauri....W.,N.	......	9	57
	ε Aurigæ...W.,N.	.....	9	13 08
	12 Can. Ven..E.,N.	+ 32	8	17 52.7
	1 Geminor..W.,N.	......	8	30
	49 Aurigæ ...W.,N.	......	7	36
	ε Bootis ....E.,N.	......	9	46
	μ Geminor..W.,N.	......	9	53
	ε Geminor..W.,N	+ 43	9	14 00
	Castor....W.,N.	+ 40	9	11
	α Cor. Bor..E.,N.	.....	6	33

Prime vertical observations—Continued.

HELL GATE.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
Apr. 19	Pollux....W.,N.	......	9	3 45
	Jupt m.^{1} .W.,N.	......	8	53
	Jupt. m.$_{2}$ .W.,N.	......	8	54
	Jupt. I L..W.,N.	......	8	54
	Jupt. II L.W.,N.	......	8	54
	Jupt. m.$_{3}$..W.,N.	+ 33	8	54
	Venus.....E.,N.	+ 21	9	50
	Capella...W.,N.	......	4	9 17 09.6
	Capella ...W.,S.	+ 44	3	17 24.0
20	Sun's I L..W.N.	+ 45	9	10 19
	Sun's 3 spots....	......	....	....
	Sun's II L.W.,N.	+ 71	9	21
	η Bootis ...E ,N.	+ 31	6	12 14
	Venus....W.,N.	......	9	20
	β Tauri....W.,N.	.....	7	25
	Aldebaran.W.,N.	......	9	35
	Arcturus...E.,N.	+ 28	6	38
21	Sun's II L.W.,N.	+ 33	5	10 25
	η Bootis ....E.,N.	+ 21	9	12 14
	Venus....W.,N.	......	8	24
	β Tauri ....W.,N.	......	6	25
	Aldebaran.W.,N.	.....	9	35
	Arcturus..E ,N.	+ 27	6	39
	? Tauri.....W.,N.	.....	3	55
	136 Tauri.....W.,N.	.....	9	58
	κ Aurigæ ...W.,N.	.....	9	13 08
	12 Can. Ven..E.,N.	+ 32	7	18
	1 Geminor..W.,N.	......	9	31
	49 Aurigæ...W.,N.	......	8	36
	ε Bootis..... E.,N.	......	9	46
	μ Geminor..W.,N.	......	9	53
	ε Geminor..W.,N.	+ 34	9	14 01
	Castor ...W.,N.	......	9	11
	α Orionis ..W.,N.	......	9	30
	α Cor. Bor...E.,N.	......	6	34
	Pollux ...W.,N.	+ 31	7	45
	Jupt. m.^{1} .W.,N.	.....	9	55
	Jupt. m.$_{2}$..W.,N.	......	9	55
	Jupt. m.$_{3}$..W.,N.	.....	9	56
	Jupt. I L..W.,N.	... ..	9	56
	Jupt. II L.W.,N.	+ 28	9	56
22	Capella...W.,N.	+ 61	4	9 17 27.7
	Capella....W.,S.	......	4	43.6
	Sun's I L..W.,S.	+ 37	9	10 24
	Sun's 3 spots....	......	....	....
	Sun's II L.W.,S.	+ 50	9	26
	η Bootis......E.,S.	+ 32	3	12 14
	β Tauri......W.,S.	......	8	25
	Venus.....W.,S.	.....	4	28
	Aldebaran.W.,S.	.....	9	35
	Arcturus...E.,S.	+ 28	7	39
	136 Tauri.....W.,S.	......	9	57
	κ Aurigæ....W.,S.	.....	9	13 08
	12 Can.Ven...E.,S.	+ 23	9	18
	1 Geminor. .W.,S.	......	3	31
	49 Aurigæ....W.,S.	......	5	36
	ε Bootis ......E.,S.	......	9	47
	μ Geminor. .W.,S.	......	8	53
	ε Geminor. .W.,S.	......	9	14 00
	Castor ....W.,S.	+ 22	9	11
	ι Geminor. .W.,N.	+ 24	5	28
	α Orionis ...W.,N.	......	4	30
	α Cor. Bor...E.,N.	......	3	34
	Pollux ....W.,N.	......	9	46
	Jup's m'n$_{1}$.W.,N.	......	9	56
	Jup's m'n$_{2}$ W.,N.	......	9	56
	Jup's I L..W.,N.	......	9	57
	Jup's II L..W.,N.	......	9	57
	Jup's m'n$_{3}$.W.,N.	+ 36	9	57
	α Cor. Bor..W.,N.	+ 19	9	22 45
	Sun's I L..E.,N.	+ 18	9	0 03
	Sun's 6 spots....	......	....	....
1860.				h. m. s.
Apr. 22	Sun's II L..E.,N.	− 6	9	0 05
	Vega ......W.,N	+ 6	6	29
	α Cygni. . W.,N.	4	3	1 13 55.4
23	Venus.....E.,N.	17	9	4 07
	Jup'r......E.,N.	24	9	6 01
	Capella ...W.,N.	+ 60	3	9 17 49.7
	Capella....W.,S.	......	3	17 55.0
	Sun's I L..W.,S.	+ 49	9	10 26
	Sun's 4 spots .W.	......	..	....
	Sun's II L.W.,S.	+ 74	9	29
	Moon's I L W.,S.	50	9	11 41
	η Bootis .....E ,S.	+ 53	9	12 14
	β Tauri .....W.,S	.....	9	25
	Venus ....W.,S	......	8	32
	Aldebaran.W.,S	.....	4	35
	Arcturus . .E ,S.	.....	7	39
	Arc. companion ..	+ 49	4	39
	136 Tauri .....W.,S.	......	9	58
	κ Aurigæ....W.,S.	......	9	13 08
	12 Can. Ven..E.,S .	+ 40	2	18
	α Serpentis ..E.,S.	......	7	20
	1 Geminor...W.,S.	......	7	31
	49 Aurigæ....W.,S.	+ 39	6	36
	ε Bootis .....E.,S.	......	9	47
	μ Geminor ..W.,S.	......	8	53
	ε Geminor ..W.,S.	......	9	14 01
	Castor ....W.,S.	+ 29	7	11
	ι Geminor..W.,N.	....	4	28
	α Orionis ...W.,N.	......	7	30
	α Cor. Bor...E.,N.	+ 34	7	34
	Pollux....W.,N.	......	9	46
	Jup's m'n$_{1}$.W.,N.	......	9	57
	Jup's m'n$_{2}$.W.,N.	......	9	57
	Jup's I L..W.,N.	.....	9	57
	Jup's II L..W.,N.	......	9	57
	Jup's m'n$_{3}$.W.,N.	....	9	58
	Jup's m'n$_{4}$.W.,N.	+ 37	9	58
	Sun's I L..E.,N.	+ 29	9	0 06
	Sun's 3 spots....	......	...	....
	Sun's II L.E.,N.	− 30	9	11
	Vega .....W.,N.	− 3	9	29
	α Cygni.....W.,N.	......	4	1 14 03.2
	α Cygni .....W.,S.	+ 13	5	14 15.5
	Moon's I L.E.,N	33	9	4 00
	Venus.... E ,N	+ 43	9	12
24	η Bootis .....E ,S.	− 2	9	12 14
	β Tauri.... W.,S.	+ 1	9	26
	Moon's I L.W.,S	......	9	36
	Venus.....W ,S.	......	9	36
	Arcturus...E.,S.	+ 1	3	39
	136 Tauri .....W.,S.	......	5	58
	κ Aurigæ ....W.,S.	......	1	13 06
	12 Can. Ven ..E.,S.	......	6	16
	α Serpentis ..E.,S.	− 1	1	19
	ε Bootis .....E.,S	......	7	47
	? Bootis .. E.,S.	+ 6	2	43
	α Orionis ...W.,S.	......	9	14 30
	α Cor. Bor...E.,S.	......	1	34
	Pollux ....W.,S.	+ 5	7	46
	Jup's m'n^{1}.W.,S.	......	9	57
	Jup's m'n$_{2}$.W.,S.	......	9	58
	Jup's m'n$_{3}$.W.,S.	......	9	58
	Jup's I L..W.,S.	......	9	58
	Jup's II L.W.,S.	......	9	58
	Jup's m'n..W.,S.	......	9	58
	Jup. comp.W.,S.	......	8	15 07
	Sun's I L..E.,S.	+ 21	9	0 14
	Sun's 3 spots..S.	......	...	....
	Sun's II L..E.,S.	− 33	9	16
	Vega......W.,S.	− 13	9	28
	α Cygni.....W.,S.	+ 2	5	1 14 17.9
	Venus.....E.,S.	+ 4	9	4 16

Prime vertical observations—Continued.

HELL GATE.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire. h.	m.	s.
1860. Apr. 24	Moon's I L..E.,S.	0	9	5	01	
25	Jup'r I L...E.,S.	− 2	7	6	02	
	Jup'r II L..E.,S.	.....	7		02	
	Sun's I L..W.,S.	+ 6	9	10	31	
	Sun's 3 spots..S.	.....	.....	.....	.....	.....
	Sun's II L.W.,S.	+ 10	9		34	
	η Bootis......E.,S.	6	9	12	14	
	β Tauri.....W.,S.	+ 10	9		26	
	Aldebaran W.,S.	.....	9		35	
	Venus....W.,S.	+ 13	9		41	
	136 Tauri.....W.,S.	.....	9		58	
	κ Aurigæ........S.	.....	9	13	09	
	12 Can. Ven..E.,S.	+ 8	4		18	
	α Serpentis ..E.,S.	.....	8		20	
	1 Geminor ..W.,S.	.....	8		31	
	49 Aurigæ ... W.,S.	.....	3		37	
	Moon's I L.W.,S.	.....	9		42	
	Moon's II L.W.S.	.....	5		46	
	μ Geminor ..W.,S.	.....	9		53	
	ε Geminor ..W.,S.	+ 2	9	14	01	
	Castor ....W.,S.	.....	9		12	
	? Orionis....W.,S.	.....	6		23	
	α Orionis....W.,S.	.....	9		30	
	α Cor. Bor...E.,S.	+ 6	6		35	
	Pollux ....W.,S.	.....	9		46	
	δ Geminor ..W.,S.	?	6		52	
	Jupt. m'n₁.W.,S.	− 1	9	14	58	
	Jupt. m'n₂ W.,S.	.....	9		58	
	Jupt. m'n₃ W.,S.	.....	9		58	
	Jupt I L....W.,S.	.....	9		58	
	Jupt. II L..W.,S.	.....	9		59	
	Jupt. m'n₄ W.,S.	.....	9		59	
	Jupt.comp.W.,S.	.....	9	15	07	
	Sun's I L...E.,S.	+ 7	9	0	19	
	Sun's 3 sp's.E.,S.	.....	.....	.....	.....	.....
	Sun's II L..E.,S.	.....	9		22	
	Vega......W.,S.	− 8	8		29	
	α Cygni .....W.,S.	− 6	3	1	14	26.10
26	β Tauri.....W.,S.	.....	3	12	25	
	Aldebaran.W.,S.	.....	5		35	
	Arcturus...E.,S.	.....	9		39	
	Venus....W.,S.	+ 48	8		44	
	α Serpentis..E.,S.	+ 42	9	13	20	
	1 Geminor. W.,S.	.....	6		31	
	49 Aurigæ...W.,S	.....	7		37	

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire. h.	m.	s.
1860. Apr. 26	ε Bootis ....E.,S.	.....	5	13	47	
	μ Geminor..W.,S.	.....	9		53	
	ε Geminor..W.,S.	+ 35	9	14	01	
	Castor ...W.,S.	.....	7		11	
	? Orionis ..W.,S.	.....	5		23	
	α Orionis .. W.,S.	+ 35	9		30	
	α Cor. Bor...E.,S.	+ 36	4		34	
	Pollux....W.,S.	.....	9		45	
	Moon's I L.W.,S.	.....	9		56	
	Jupt. m'n₁.W.,S Jupt. m'n₂.W.,S	.....	9		59	
	Jupt. I L.W.,S.	.....	9		59	
	Jupt. II L.W.,S.	.....	9		59	
	Jupt. m'n₃.W.,S.	+ 44	8		59	
	Jupt. comp.W.,S.	.....	3	15	07	
	Sun's I L..E.,S.	+ 30	3	0	23	
	Sun's II L.E.,S.	24	8		26	
28	α Cygni ....W.,S.	+ 13	3	1	13	17.7
	Ven. sun...E.,S.	− 27	9	4	40	
29	Capella ..W.,S.	34	1	9	16	09.2
	Sun's I L.W.,S.	− 31	7	10	43	
	Sun's 4 sp's.W.,S.	.....	.....	.....	.....	.....
	Sun's II L....S.	− 23	9		46	
	Arcturus...E.,S.	− 23	6	12	41	
	α Orionis ..W.,S.	.....	9	14	32	
	α Cor. Bor...E.,S.	− 44	7		36	
	Pollux. ..W.,S.	.....	9		47	
	δ Geminor. W.,S.	.....	9		54	
	Jupt. m'n₁.W.,S.	− 20	9	15	03	
	Jupt. m'n₂.W.,S.	.....	9		03	
	Jupt. I L. W.,S.	.....	9		03	
	Jupt. II L.W.,S.	.....	9		03	
	Jupt. m'n₃.W.,S.	.....	8		03	
	Moon's I L.W.,S.	− 27	9	18	58	
	Vega.... W.,S.	.....	9		30	
	Sun's I L..E.,S.	.....	9		41	
	Sun's 5 spots....	.....	.....	.....	.....	.....
	Sun's II L.E.,S.	− 86	9		44	
	α Cygni....W.,N.	.....	5	1	16	07.0
	α Cygni ....W.,S.	− 81	4		16	16.5
	Venus....E.,N.	− 56	9	4	44	
30	Sun's I L.W.,N.	.....	9	10	45	
	Sun's 4 spots ...	.....	.....	.....	.....	.....
	Sun's II L.W.,N.	+159	9		48	

TRANSIT OBSERVATIONS.

FORT BENTON.

May 25	Moon's I L..W.	− 14	9	11	52	07.60
	α Leonis......W.	19	7	13	01	37.10
	γ¹ Leonis......W.	− 21	6		13	26.7
	δ Leonis......W.	.....	1	14	07	
	α Urs. Maj.....W.	− 22	9		01	16.22
	β Leonis..... W.	.....	9		42	49.76
	Polaris ......W.	− 22	7		24	27.2
	Polaris......E.	21	7		30	56 7
	Polaris......W.	− 29	8		40	20.0
	γ Urs. Maj.....W.	.....	9		51	01.26
	Polaris ......W.	− 23	9		56	44.6
	Polaris.......E.	21	9	1	04	21.9
	η Virginis.......E.	− 19	6		12	
	β Corvi ....E.	.....	9		25	33.21
	α Pegasi	+ 9	9	2	01	15.73
26	Polaris .... ..E.	+ 12	4	3	50	57.2
	Polaris......W.	+ 7	4		59	59.7
	Polaris......W.	− 8	6	4	29	54.8
	α Persei......W.	− 4	6	6	18	
27	Venus.......W.	.....	4	10	35	
	Pollux.... ..W.	− 48	4		40	

May 27	ι Urs. Maj.....W.	− 41	2		53	
	α Hydræ......W.	.....	9	12	24	
	θ Urs. Maj.....W.	− 54	4		27	
	Saturn cent..W.	− 59	9		36	
	γ¹ Leonis ......W.	+ 7	8	13	16	10.78
	ρ Leonis ......W.	8	6		29	21.98
	Moon's I L..W.	7	9		44	15.32
	δ Leonis ......W.	+ 8	6	14	10	
	ο Leonis ......W.	.....	5		17	
	ι Leonis ......W.	+ 6	6		20	
	γ Cephei.......W.	.....	4	14	37	
	υ Virginis .... W.	.....	9		42	36.36
	β Virginis......W.	.....	8		47	20.83
	γ Urs. Maj.. ..W.	+ 9	6		50	
	π Virginis... .W.	.....	0		57	38.69
	ο Virginis ......W.	.....	9	15	02	01.31
	Polaris.......W.	.....	1		05	30.4
	Polaris....... E.	+ 16	1		12	47.8
	η Virginis ....E.	.....	9		16	00.00
	Polaris.......W.	+ 12	2		21	14.1
	Polaris........E.	+ 18	2		28	30.0
	β Corvi ....E.	.....	8			

Transit observations—Continued.

FORT BENTON.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.	1860.				h. m. s.
May 27	Polaris.......W.	......	3	15 37 01.0	May 31	β Libræ . .....E.	− 11	4	18 14
	α Cassiopeæ ..W.	......	2	38	June 2	Pollux ....E.	+ 62	3	10 41
	Polaris........E.	+ 16	3	43 42.1		Venus ....E.	+ 64	8	55
	ε Pegasi.........E.	66	5	41		α Persei ....E.	+ 82	8	6 19
	α Aquari........E.	+ 56	4	1 02	3	Sun's I L .....E.	+ 65	9	7 51
28	α Urs. Maj .. . E.	− 24	9	13 59		Sun's 6 spots. E.	......	.....	....
	δ Leonis........E.	......	6	14 09		Sun's II L ....E.	+ 78	9	53
						Rigel ....E.	+ 41	7	8 12
	Moon's I L....E.	− 35	9	36 52.19		Castor ....E.	+ 6	9	10 30
	υ Virginis ....E.	......	5	42 36.34		Procyon ....E.	− 22	9	37
	β Virginis .... .E.	− 28	9	47 20.36		β^1 Scorpii ....E.	+ 50	9	19 02 20.18
	κ Virginis .... .E.	.....	2	57 39.85		δ Ophiuchi......E.	......	2	12 11.0
	ο Virginis .... .E.	− 48	9	15 02 01.50		σ Scorpii ....E.	+ 43	9	16 51.90
	η Virginis ....E.	......	9	16 41.71		α Scorpii ....E.	....	8	26 00.87
	ο Virginis ....E.	......	1	17		τ Scorpii ....E.	......	9	32 21.79
	β Corvi ....E.	− 50	9	30 58.53		24 Scorpii ....E.	+ 43	9	38 40.38
	γ Virginis.......E.	......	9	38 31.53		20 Ophiuchi .....E.	......	9	47 16.66
	38 Virginis ....E.	.....	9	40 58.72		η Ophiuchi .. .E.	+ 44	9	20 07 22.39
	12 Can. Ven .....E.	......	8	53		A Ophiuchi .....E.	+ 47	6	11 56.36
	Polaris.........E.	− 47	4	58 24.8		θ Ophiuchi .....E.	......	6	18 36.80
	Polaris.......W.	− 59	5	16 06 47.9		B Ophiuchi .... E.	......	8	23 01.40
	Moon's I L ..E.	− 15	9	15 30 06.17		Moon's I L ..E.	......	9	26
	γ Virginis.......E.	− 10	9	38 44.50		Moon's II L..E.	+ 47	9	29 15.67
	38 Virginis.......E.	......	6	50		ο Serpentis .....E.	+ 48	9	36 44.58
	ψ Virginis.......E.	......	5	51		γ Draconis......E.	+ 53	9	58 25.78
	δ Virginis.......E.	......	3	52		μ^1 Sagittarii .....E.	+ 56	8	21 10 36.00
	θ Virginis....... E.	......	7	16 06		δ Urs. Min......E.	......	6	27 16.2
	Polaris.........E.	− 15	5	16 30.3		Vega ....E.	+ 99	7	37 19.34
	α Virginis ......W.	......	9	22 11.51	4	ε Urs. Min......E.	+ 53	4	20 05 01.2
	Polaris ....W.	− 20	6	24 46.5		Capella ....E.	......	7	11 56.9
	ζ Virginis ......W.	− 19	6	31		θ Ophiuchi .....E.	......	5	16 40.44
	Polaris ....W.	......	7	40 43.2		b Ophiuchi .....E.	......	9	23 13.67
	η Urs. Maj .....W.	......	8	46		c^2 Ophiuchi .....E.	+ 58	9	28 17.14
	η Bootis.........W.	− 13	9	52 23.12		α Ophiuchi .....E.	......	5	33 48.00
	Polaris.........E.	......	4	3 50 10.0		ε Serpentis .....E.	+ 52	9	36 57.02
	Polaris.........E.	+ 3	6	4 21 13.3		4 Sagittarii .....E.	......	9	56 30.61
	Polaris ....W.	− 7	6	26 18.7		γ Sagittarii .....E.	+ 55	8	21 08 13.94
30	Sun's I L ....W.	− 33	9	7 34		μ^1 Sagittarii .....E.	+ 53	9	10 46.26
	Sun's 7 spots.W.	......	.....	....		δ Sagittarii .....E.	+ 47	9	17 27.30
	Sun's II L....W.	− 2	9	36		λ Sagittarii .....E.	......	9	24 44.94
	Capella........W.	......	4	8 10		Moon's II L .E.	......	9	30 40.40
	Rigel.......... W	− 5	8	12		Bradley, 2333. E.	......	9	35 24.90
	α Pis. Aust .....W.	+ 1	9	1 54		Vega ....E.	......	5	37 31.45
	α Pegasi ....W.	......	9	2 02		φ Sagittarii .....E.	......	8	42 20.02
	α Andromedæ .W.	+ 11	9	3 05		29 Sagittarii .....E.	......	9	46 47.03
	Polaris ....W.	+ 5	1	11 59.9		ν^1 Sagittarii .. E.	......	4	51
	Polaris.........E.	+ 12	2	20 38.3		σ Sagittarii ... E.	+ 53	5	58
	Polaris ....W.	+ 12	2	27 35.3		ζ Sagittarii .....E.	......	8	59 07.62
	Polaris.........E.	+ 27	3	36 19.3		τ Sagittarii ... E.	+ 52	9	22 03 37.38
	α Cassiopeæ ....E.	......	4	36		λ Urs. Min......E.	+ 57	3	22 30.7
	Polaris ....W.	+ 94	3	43 04.7		λ Urs. Min .....W.	+ 52	3	30 47.4
	Polaris....... E.	+ 30	4	51 56.3		γ Aquilæ...... W.	......	7	45
	Polaris ....W.	+ 24	4	58 50.2		α Aquilæ ......W.	......	9	49 31.94
	Polaris.........E.	+ 28	5	4 07 27.2		β Aquilæ ....W.	+ 56	1	53
	Polaris ....W.	+ 19	5	4 14 41.2		α Cassiopeæ....W.	+ 55	3	3 38
	Polaris....... E.	+ 26	6	23 04.6		Polaris....... E.	+ 68	4	52 06.1
	Polaris ....W.	+ 15	6	29 51.6		Polaris ....W.	+ 57	4	59 00.1
	Polaris.........E.	+ 26	7	39 01.8		Polaris... ... E.	+ 69	5	4 07 26.8
	Polaris ....W.	+ 12	7	45 23.9		Polaris ....W.	+ 63	5	14 40.7
	Polaris....... E.	+ 20	8	54 16.3		Polaris.........E.	+ 64	6	23 11.8
	Polaris ....W.	+ 13	8	5 01 10.5		Polaris ....W.	+ 50	6	30 00.0
	α Arietis ....W.	......	8	03		Polaris.........E.	+ 51	7	39 07.3
	Polaris.........E.	+ 24	9	10 04.2		Polaris ....W.	+ 30	7	45 52.7
	Polaris ....W.	+ 15	9	17 07.3		Polaris.........E.	+ 41	8	54 37.1
31	ζ Virginis...... E.	− 20	3	16 32		Polaris ...... W.	+ 36	8	5 01 36.7
	η Bootis ....E.	......	4	52		Polaris....... E.	+ 53	9	10 11.8
	Polaris.........E.	− 21	8	17 03 23.7		Polaris ....W.	+ 47	9	17 20.5
	Arcturus. .....E.	......	9	13 50.1		α Arietis ....W.	+ 55	8	04
	Moon's I L ..E.	− 12	8	22 07.92	5	Polaris.........E.	+ 20	6	16 33 30.8
	μ Virginis.......E.	......	8	40 16.00		Polaris ....W.	+ 15	7	42 04.5
	ε Bootis ....E.	......	5	43		η Urs. Maj .....W.	......	9	47
	β Urs. Min......E.	− 21	7	55		η Bootis ....E.	+ 17	9	53

Transit observations—Continued.

FORT BENTON.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.		
				h.	m.	s.
1860. June 6	Sun's I L.....W.	+ 23	9	8	04	
	Sun's 6 spots.W.	......	....	.....	.....	.....
	Sun's II L....W.	+ 22	9		07	
	b Sagittarii....W.	......	8	22	54	22.55
	A Sagittarii....W.	+ 34	4		56	26.62
	c Sagittarii....W.	......	7	23	00	03.76
	Mars ....W.	......	9		16	42.63
	Moon's II L.W.	+ 28	9		22	21.79
	α Cygni.......W.	+ 22	9		42	38.27
	ζ Cygni.......W.	......	8	0	12	
	α Cephei......W.	......	9		21	15.02
	β Cephei......W.	+ 36	9		32	53.11
	ε Pegasi.......W.	+ 30	2		43	
7	Procyon.....W.	......	3	10	38	
	Pollux.......W.	− 19	6		42	
	Jupiter.......W.	24	9		56	
	Venus.......W.	30	9	11	09	
	α Urs. Maj....W.	− 41	9	14	01	
	δ Leonis.......W.	......	9		12	
	Mars ....W.	......	1	23	17	
	? ....W.	− 11	4		28	
	? ....W.	......	9		37	
	ε Cygni.......W.	− 16	7		42	51.34
	ν Aquarii ....W.	20	9	0	08	10.74
	Moon's II L.W.	− 16	9		12	30.06
	ι Capricorni ..W.	......	2		20	39.35
	ζ Capricorni ..W.	− 11	7		24	53.99
	β Aquarii .....W.	......	7		30	
	γ Capricorni ..W.	− 12	8		38	
	ε Pegasi ......W.	......	8		43	
	δ Capricorni ..W.	− 12	4		45	
	α Aquarii .....W.	13	9	1	04	47.97
	Sun's I L. ..W.	− 41	9	8	13	
	Sun's 7 spots W.	......	....	.....	.....	.....
	Suns II L....W.	− 14	9	8	15	
8	π Capricorni...W.	......	4	23	25	
	ρ Capricorni...W.	......	2		28	
	Capricorni...W.	+ 22	2		28	
	ν Capricorni...W.	......	9		38	
	α Cygni.......W.	+ 21	6		43	
	ν Aquarii .....W.	......	9	0	08	23.76
	ζ Cygni.......W.	+ 19	9		13	22.97
	ι Capricorni.. W.	......	7		20	
	ζ Capricorni...W.	+ 21	9		25	07.09
	β Aquarii .....W.	......	8		30	
	γ Capricorni...W.	......	8		38	
	ε Pegasi ....W.	......	7		43	
	Moon's II L.W.	+ 23	2		59	
9	β Leonis ......W.	− 31	9	14	46	
	γ Urs. Maj....W.	− 32	8		53	
	12 Can. Ven....W	......	5	15	56	
	Polaris.......W.	− 29	1		08	28.2
	Polaris....... E	22	1		15	45.3
	Polaris.......W.	30	2		24	18.1
	Polaris........E	23	2		31	25.0
	Polaris.......W.	32	3		39	58.0
	Polaris........E.	22	3		46	43.2
	Polaris .....W.	31	4		55	29.1
	Polaris........E.	24	4	16	02	38.3
	Polaris ......W.	30	5		10	55.1
	Polaris........E.	25	5		18	10.2
	α Virginis.......W.	32	9		24	
	Polaris.......W.	33	6		26	25.6
	Polaris........E.	25	6		33	32.5
	Polaris.......W.	− 30	7		42	23.8
	η Urs. Maj....W.	......	4		48	
	Polaris........E.	− 17	....		49	08.2
	Polaris..... W.	19	8		57	49.4
	Polaris........E.	13	8	17	04	48.2
	Polaris ......W.	23	9		13	21.4
	Arcturus....W.	− 17	5		15	
1860. June 9	Polaris........E.	− 16	9	17	20	32.7
	α¹ Capricorni ...E.	+ 24	7	23	16	
	α² Capricorni .. E.	......	6		16	
	Mars ....E.	+ 23	7		18	
	ρ Capricorni ...E	......	5		27	
	ν Capricorni ...E.	......	9		38	31.94
	α Cygni........E.	......	9		43	01.58
	ω Capricorni ...E	+ 26	9		49	55.20
	? ....E.	......	5	0	04	
	61¹ Cygni.........E.	......	9		07	
	? Cygni.........E.	......	9		07	
	ζ Cygni ....E.	+ 20	9		13	
	α Cephei ....E.	28	9		21	30 49
	β Aquarii ....E.	+ 33	9		30	38.56
	β Cephei. ......E.	......	5		32	
	γ Capricorni ....E.	......	6		38	
	ε Pegasi ....E.	......	9		43	44.94
	δ Capricorni ....E.	+ 31	5		45	
	α Aquarii ....E.	31	9	1	05	02.68
	ζ Pegasi ....E.	33	3		40	55.5
	Moon's II L...E.	36	9		44	14.94
	α Pis. Aust.... E.	+ 37	9		56	22.44
19	Capella ....W.	......	5	8	15	
	Rigel ....W.	− 19	6		16	
	β Tauri ....W.	......	3		26	
	ε Orionis......W.	+ 1	4		37	
	α Orionis......W.	− 30	8		56	
20	Sun's I L....W.	......	7	9	05	
	Sun's 5 spots W.	......	....	.....	.....	.....
	Sun's II L...W.	− 63	9	9	08	
	Sirius ......W	76	9		47	39.78
	Mercury......W.	− 86	9	10	16	58.21
	Castor ......W	......	5		34	23.72
	Moon's I L...W.	− 84	9		39	27.21
	Procyon......W.	......	2		40	40.9
	Pollux ....W.	......	9		45	28.38
	Jupiter's I L.W	......	9	11	09	59.24
	Jupiter's II L W.	− 92	9		10	01.32
	Venus's I L..W.	96	9		33	54.78
21	Jupiter ......W.	16	1	11	11	
	Regulus .....W.	48	2	13	09	
	β Leonis ......W.	− 52	7	14	50	
	η Virginis .... .E.	......	4	15	21	
	Polaris.. ....W	− 51	1		10	54.0
	Polaris........E.	49	1		17	55.5
	Polaris.......W.	48	2		26	57.5
	Polaris........E.	− 44	2		33	44.7
	β Corvi ....E.	......	5		35	
	γ Virginis ....E.	− 48	7		43	
23	α Hydræ ....W	+ 26	1	12	29	
	Moon's I L...W.	......	8	13	33	
	α Urs. Maj ....W.	− 20	9	14	04	
	δ Leonis.......W.	85	9		15	
	β Leonis.......W.	− 76	6		51	
	γ Urs. Maj.....W.	......	8		55	
	Polaris.......W.	− 82	1	15	09	57.9
	Polaris ....W.	84	2		25	57.0
	Polaris.......W.	80	3		41	50.6
	γ Virginis......W.	− 89	5		43	
	δ Virginis. .....W.	......	9		57	
	Polaris.......W.	− 97	5	16	12	32.7
	Polaris........E.	102	5		18	31.4
	Polaris.......W.	− 90	6		28	05.8
June 24	Sun's I L.....E	+ 9	9	9	22	
	Sun's 7 spots E.	......	....	.....	.....	.....
	Sun's II L....E	− 4	8		25	
	Moon's I L....E.	− 26	9	14	26	
	β Leonis.........E.	......	5		51	
	γ Urs. Maj......E.	− 26	6		55	
	γ Virginis ....E.	− 36	9	15	43	
	δ Virginis ......E.	......	3		57	

Transit observations—Continued.

FORT BENTON.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.
June 24	Polaris.......E.	− 36	4	16 00 59.8
	Polaris ..... W.	36	5	16 10 43.1
	Polaris.......E.	− 36	5	16 37.0
	Capella ......W.	+ 2	9	20 15
	Polaris ......W.	35	6	4 38 07.5
	Polaris ..... E.	37	7	48 27.3
	Polaris . .....W.	+ 36	7	53 35.9
	Polaris ......E.	− 94	8	5 06 11.9
	Polaris. .....W.	−103	8	12 09.7
	Polaris ......E	+ 75	9	20 17.1
	Polaris . .....W.	68	9	25 59.2
	β Urs. Min.....W.	65.5	1	54 07.5
	β Urs. Min.....W.	66.5	2	55 34.4
	β Urs. Min.....W.	+65.5	3	57 03.3
	β Urs. Min.....W.	− 9.5	4	58 29.8
	β Urs. Min.... W.	9.5	5	59 58.0
	β Urs. Min.... W.	9.5	6	6 01 27.7
	β Urs. Min.... W.	132	7	02 53.9
	β Urs. Min... W.	132	8	04 18.5
	β Urs. Min.....W.	132	9	05 47.0
	α Persei ...... W.	134	6	24
	Aldebaran ..W.	−152	9	7 37
	Capella . .....W.	+ 45	5	8 15
	Rigel ....W.	+ 54	7	17
	β Tauri ......W	.....	9	27
25	Sun's I L...W.	+ 31	9	9 27
	Sun's 10 spots W.	....	...	....
	Sun's II L...W.	+ 25	9	29
	Sirius........W.	23	9	48
	Castor ....W.	+ 9	5	10 35
	Procyon .....W.	......	9	41
	Pollux ....W.	....	8	46
	Mercury .....W.	+ 2	9	56
	Jupiter I.... W.	.....	9	11 16
	Jupiter II....W.	+ 2	9	16
	Venus I .....W.	....	9	37
	Saturn.......W.	− 4	9	12 51
	Regulus .....W.	3	9	13 10 29.47
	α Urs. Maj.....W.	25	9	14 04
	δ Leonis...... W.	− 32	9	16
	β Leonis ......W.	....	9	51
	γ Urs. Maj ....W.	− 31	7	56
	Moon's I L...W.	36	9	15 19
	β Corri ....W.	− 44	4	36
	γ Virginis......W.	......	7	44
	δ Virginis......W.	......	9	58
	12 Can. Ven. W.	− 50	3	59
	α Virginis ......W.	......	7	16 27
	Polaris.......W.	......	6	10
	Polaris ......E.	......	2	16
	* .... W.	......	8	19 18
	Comet .... W.	......	9	47
	Vega ....W.	....	6	21 18
	Mars ....W.	......	9	24
	α Aquilæ.......W.	− 65	9	39
	ς................	......	6	53
	α Urs. Maj.... W.	......	9	22 09
	α Persei ....W.	......	9	6 28
	Capella ......W.	.....	9	8 10
	Sun's I L...W.	− 4	9	40
	Sun's 9 spots ...	......	....	....
	Sun's II L ..W.	......	7	42
26	Mercury ....W.	......	8	10 10
1860.				h. m. s.
June 26	Jupiter.......W.	−102	3	10 21
	Venus I L ..W.	95	9	38
	δ Leonis ......W.	130	8	13 22
	Sirius........W.	− 33	9	8 04
	Capella...... W.	......	4	10
	Sun's I L....W.	......	9	44
	Sun's 10 spots W.	.....	.....	....
	Sun's II L..W.	......	9	47
27	α Virginis ....W.	−105	7	14 51
	γ Urs. Maj.... W.	−110	6	15 29
	Moon's I L..W.	......	1	18
	Moon's I L..W	......	9	16 07
	? α Serpentis ...W.	....	3	18 32
	Capella ..N.,W.	.. ...	9	49
	η Ophiuchi	.....	9	19 15
	*................	+ 4	5	43
	? Sagittarii....	15	8	20 06
June 29	Sirius ...... E.	70	9	8 04
	Capella ......E.	137	9	10
	Sun's I L....E.	+ 56	8	57
	Sun's 10 spots E.		...	....
	Sun's II L....E.	+ 40	9	59
June 30	Procyon .....E	+ 22	9	9 26
	Jupiter ......E.	......	9	10 25
	Venus' I L...E.	− 33	9	36
	γ Urs. Maj......E.	66	5	15 20
	Arcturus.....E	− 64	9	16 23
	α Cor. Bor ......E.	......	9	17 54
	Moon's I L ..E.	− 57	9	18 03
	η Ophiuchi ....E.	......	9	29
	? ξ Ophiuchi ... E.	.....	3	32
	b or c^1 Ophiuchi ..E.	− 64	9	37
	N * 6 mag ...	− 64	8	58
	Comet is faint th	rough	the	North. Light.
July 1	Sirius.........E.	+ 26	9	8 04
	Capella ......E.	51	9	11
	Sun's I L....E.	+ 22	9	9 01
	Sun's 10 spots...	......	...	....
	Sun's II L ...E.	+ 23	9	04
	Procyon ......E.	+ 10	8	26
	Jupiter ..... E.	− 14	9	10 26
	Venus' I L ..E.	.....	9	35
	Mercury	− 35	9	40
	Moon's I L ..E.	13	9	19 31
	μ^1 Sagittarii ... E.	28	9	43
	? Sagittarii ... E.	− 28	9	20 10
	σ Sagittarii ... E.	......	7	23
	ξ Sagittarii.....E.	......	3	26
	τ Sagittarii ....E.	− 29	9	33
	β Draconis.....E.	8	9	49
	Vega ....E.	− 8	9	21 24
	Mars I L.....E.	.....	9	47
	Mars II L....E.	− 21	9	47
	α Aquilæ ......E.	− 14	9	58
	Sirius ....E.	.....	9	8 05
	Capella ....E.	− 16	5	11
	Sun's I L....E.	− 10	9	9 06
	Sun's 10 spots E	.... .	....	....
	Sun's II L ...E	− 40	9	08
	Jupiter........E.	89	9	10 27
	Venus I L ...E.	91	9	35
	Mercury.....E.	− 93	9	46

PRIME VERTICAL OBSERVATIONS.

FORT BENTON.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
				h. m. s.
1860. May 27	Sun's I L..E.,N	......	8	2 49
	Sun's 5 spots..N.	...	...	....
	Sun's II L....N.	—112	9	52
	Jupiter....E.,N.	+ 22	2	6 12
	Venus ....E.,N.	15	9	17
	Capella ....E.,N.	28	2	47 42.2
	Capella ..W.,N.	+102	6	9 35 50.1
28	Arcturus..E.,N.	......	3	12 31
	Sun's I L.W.,N.	+ 42	9	03
	Sun's 6 spots.N.	...	...	....
	Sun's II L...N	+ 39	9	06
	α Cygni ....W.,N.	— 9	9	1 26
	Sun's I L.E.,N.	— 1	8	2 54
	Sun's 6 spots.N.	...	....	....
	Sun's II L.E.,N.	+ 28	9	56
	Jupiter I ..E.,N.	+ 56	9	6 12
	Jupiter II.E.,N	......	8	12
	Venus ....E.,N.	+ 81	9	19
	Pollux....E.,N.	......	9	38
	Capella...E.,N.	......	7	47 34.7
	Castor....E.,N.	+ 97	4	49
29	Capella..W.,N.	114	8	9 35 40.0
	Sun's I L.W.,N.	+ 86	9	12 07
	Sun's 5 spots.N.	......	...	....
	Sun's II L...N.	+ 78	9	09
	Arcturus..E.,N.	125	9	31
	12 Can.Ven.. E.,N.	+149	2	13 05
	ε Bootis ....E.,N.	......	1	38
	Pollux ...W.,N.	....	1	14 46
30	Jupiter I..E.,N.	+ 20	2	6 14
	Jupiter II..E.,N.	......	2	14
	Venus ....E.,N.	+ 94	9	24
	Pollux ...E.,N.	......	6	39
	Capella ...E.,N.	......	9	47
	Castor ...E.,N.	+ 18	5	50
31	Jupiter ...W.,N.	+ 34	2	15 25
June 4	Venus.....E.,N.	— 24	9	6 34
	Capella ...E.,N	— 19	2	47
5	Capella...W.,N.	+ 3	1	9 36
	α Cor. Bor ..E.,N.	18	4	14 25
	Pollux ...W.,N.	+ 22	3	45
	Jupiter I..W.,N.	......	6	15 31
	Jupiter II.W.,N.	.....	6	31
	Venus ....W.,N	+ 30	6	35
10	Capella...W.,N.	61	9	9 38
	Sun's I L.W.,N.	50	1	12 52
	α Cor. Bor..W.,N.	+ 19	4	22 45
	* ....W.,N.	......	5	23 07
	* ....W.,N	— 14	1	21
	* ....W.,N.	.....	3	47
	* ....W.,N.	......	8	47
	Vega......W.,N	— 20	9	0 33
	α Cygni ...W.,N.	— 17	3	1 26
	Sun's I L.E.,N.	— 11	9	3 56
	S's 3 spots.E.,N.	......	...	....
	Sun's II L.E.,N	— 1	8	58
	Capella ...E.,N.	+ 11	....	Clouds ....
11	Capella ......W.	55	9	9 38
	Arcturus .E.,N.	+ 75	9	12 32
	Sun's I L W.,N.	......	9	56
	Sun's II L W.,N.	......	9	58
	Sun's 6 sp's W.,N.	...	....	....
	12 Can. Ven..E.,N.	+ 26	6	13 05
	α Cor. Bor ..E.,N.	.....	1	14 27
	Pollux... N., W.	+112	3	47
12	Arcturus..E.,N.	28	9	12 33
	Sun's I L.W.,N.	+ 44	9	13 00
	S's 3 spots W.,N.	......	....	....
	Sun's II L W.,N.	+ 75	9	02
	ε Bootis .. E.,N.	+121	3	39
1860. June 12	Pollux....W.,N.	......	2	47
14	Sun's I L.W.,N.	+ 16	9	13 08
	S's 4 spots.W.,N.	... ...	...	... ...
	Sun's II L.W.,N.	— 33	9	10
	ε Bootis ....E.,N.	+ 12	8	40
	Jupiter....E.,N.	— 19	9	6 27
	Capella ...E.,N	......	7	49
	Venus ....E.,N.	+ 18	5	47
	α Androm..W.,N.	+ 6	7	7 12
	Regulus....E.,N.	— 3	2	55
16	12 Can. Ven .E.,N.	+ 5	3	13 06
	Sun's I L.W.,N.	... ...	1	16
	Jupiter I .W.,N.	+ 23	6	15 44
	Jupiter II.W.,N.	.....	6	44
	Venus I..W.,N.	+ 25	9	16 10
	Capella ...E.,N	......	8	6 50
	Venus ....E.,N.	+ 5	2	48
17	Capella...W.,N.	37	2	9 39
	Sun's II L.W.,N.	48	5	13 24
	Jup'r I L .W.,N.	55	9	15 45
	Jup'r II L.W.,N	55	9	45
	Venus I L.W.,N.	52	9	16 12
	ε Leonis ...W.,N.	+ 50	7	17 09
	* Aquilæ ...E.,N.	......	9	23
	γ Aquilæ ...E.,N.	+ 48	4	25
	* ....E.,N.	......	9	41
	* ....E.,N.	......	9	41
	Saturn ...W.,N.	+ 48	9	50
	* ....W.,N.	......	1	18 01
	* ....W.,N.	......	6	03
	* ....W.,N.	+ 45	9	10
	Regulus ..W.,N	.....	9	22
	* ....E.,N.	+ 50	6	32
	Vega ......E.,N.	.....	8	46
	α Aquilæ...W.,N.	— 11	1	4 21
	Sun's I L..E.,N.	......	9	4 28
	Sun's 8 spots.N.	......	....	....
	Sun's II L ...N	+ 29	9	30
	Capella ...E.,N.	....	9	6 50 52.2
	Venus I L .E.,N.	+ 28	7	49
	α Androm..W.,N.	31	4	7 13
18	Capella...W.,N.	60	9	9 39 04.6
	Arcturus..E.,N.	90	8	12 34
	Sun's I L.W.,N.	+ 87	9	13 25
	S's 6 spots.W.,N.	......	....	....
	Sun's II L.W.,N.	+ 85	9	27
	ε Bootis ....E.,N.	96	3	40
	α Cor. Bor ..E.,N.	99	9	14 28
	Sun's I L..E.,N.	+ 26	8	4 32
	S's 8 spots ...N.	......	....	....
	Sun's II L E.,N.	+ 60	8	35
19	Capella...W.,N.	99	7	9 39
	Sun's I L.W.,N.	+121	7	13 29
	S's 2 spots ...N.	......	....	....
	Sun's II L.W.,N.	+131	3	32
	α Aquilæ...W.,N.	52	6	4 22
	Sun's I L .E.,N.	+ 52	9	37
	Sun's 10 spots.N.	......	....	....
	Sun's II L....N.	+ 83	9	39
	Mercury.. E.,N.	59	6	5 53
	Jupiter....E.,N.	+ 92	9	6 31
	Pollux ....E.,N	......	7	42
	Venus I L.E.,N.	+ 92	8	49
	Capella ...E.,N.	......	9	50
	α Androm..W.,N.	+101	5	7 13
21	Venus I L W.,N.	— 50	9	16 20
	Moon's I L.W.,N.	46	9	45
	ε Leonis ...W.,N.	— 35	9	17 10
	α Aquilæ ...E.,N.	......	9	24
	γ Aquilæ ...E.,N.	— 41	4	26
	* ....W.,N.	......	9	41

Prime vertical observations—Continued.

FORT BENTON.

Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.	Date.	Object and lamp.	Level, one-fourth divisions.	Number of wires.	Culmination over mean wire.
1860.				h. m. s.	1860.				h. m. s.
June 21	* ....W.,N.	— 33	9	42	June 22	Moon's I L.W.,N	......	4	18 06
	Saturn ...W.,N.	— 43	9	17 52		M'n's II L.W.,N.	— 40	6	10
	* ....W.,N.	......	9	18 02		* ....W.,N.	......	2	11
	* .... W.,N.	.....	9	03		Regulus ..W.,N.	.....	9	23
	* .... W.,N.	— 39	9	11		* .... E.,N.	— 39	9	31
	Regulus ..W.,N.	38	9	23		Vega ......E.,N.	......	6	47
	* .... E.,N.	33	9	30		12 Can. Ven.W.,N.	.....	5	49
	Vega ..... E.,N.	— 34	9	46		δ Leonis ...W.,N.	— 34	5	53
	12 Can. Ven.W.,N.	......	2	49		α Aquilæ ..W.,N.	9	9	4 22
	δ Leonis ...W.,N.	— 30	3	53		Sun's I L .E.,N.	— 5	8	49
	Vega......W.,N.	43	6	0 35		S's 9 spots.E.,N.	......	....	....
	α Arietis ...W.,N.	— 35	1	40		Sun's II L.E.,N.	+ 21	7	53
	α Aquilæ...W.,N.	......	3	4 23		Mercury...E.,N.	......	9	6 13
	Sun's I L..E.,N	— 46	9	45		Jupiter I ..E.,N.	+ 15	9	33
	Sun's II L E.,N.	30	9	49		Jupiter II.E.,N.	......	9	34
	Mercury...E.,N.	— 13	9	6 07		Pollux .... E.,N.	......	2	42
	Pollux ...E.,N.	......	5	42		Venus I ..E.,N.	......	6	48
	Capella ...E.,N.	— 15	5	50		Capella ...E.,N.	+ 45	8	51 20.7
	Venus I L.E.,N.	......	9	49		α Androm..W.,N.	19	9	7 13
	α Androm..W.,N.	.....	8	7 13		Moon's I L E.,N.	+ 5	9	50
	Moon's I L E.,N.	— 49	8	19		Regulus...E.,N.	— 6	5	57
22	Sun's I L.W.,N.	52	4	13 42		Capella...W.,N.	— 5	9	9 35 32.4
	Sun's II L W.,N.	54	6	45					
	Jupiter I..W.,N.	— 49	9	15 51		Comet	......	9	19 31
	Jupiter II.W.,N.	.....	9	51		*	......	4	34
	Venus I .W.,N.	— 49	9	16 22		*	......	6	41
	ε Leonis ...W.,N.	— 40	9	17 10		*	......	6	50
	α Aquilæ...W.,N.	......	9	24					
	γ Aquilæ...W.,N.	— 32	4	26		2d set.			
	* ....W.,N.	......	9	42					
	* ....W.,N.	— 47	6	42		Comet..........	......	9	20 04
	Saturn ..W.,N.	— 44	9	53		*	......	8	06
	* ....W.,N.	......	9	18 02	25	*	.....	8	19 18
	* ....W.,N.	......	7	03		Comet..........	.....	9	47

VOLUME D.

METEOROLOGICAL OBSERVATIONS MADE IN CONNEXION WITH THE CONSTRUCTION OF THE FORT WALLA-WALLA AND FORT BENTON MILITARY ROAD FROM 1859 TO 1862.

Thermometer comparisons, May 30, 31, *and June* 1, 1859.

Attached to barometer.	No. 1.	No. 2.	No. 3	No. 4.	No. 5.	No. 6.	Naked. 1507.	Black. 1505.	Max. 1530.	Wet. 80.	Dry. 40.
°	°	°	°	°	°	°	°	°	°	°	°
58.9	59.2	60.0	59.4	59.8	59.5	59.0	59.2	59.5	59.0	60.5	60.2
57.5	61.6	62.5	61.4	61.0	60.4	60.8	59.8	60.2	59.0	60.0	60.0
63.5	66.0	67.5	65.6	65.8	64.5	64.5	65.0	65.2	64.6	64.5	64.5
62.5	63.3	64.5	64.2	64.2	63.8	64.0	63.7	64.4	63.2	....	64.0
60.6	61.8	63.0	62.0	61.0	61.0	61.5	61.4	61.7	61.0	....	62.5
59.0	59.4	60.3	59.8	59.8	.97	59.7	59.4	59.7	59.1	....	....
48.5	47.0	48.0	47.8	48.0	48.0	48.0	......	......	....	....	....
44.6	45.2	43.0	45.2	45.8	45.3	45.0	44.8	45.3	44.5	......	45.6
....	......	......	......	......	......	......	......	......	......	60.2	60.2

October 16, 1859.—Temperature of melted snow by thermometer No. 2, 32°.9.

NEW FORT WALLA-WALLA.

1859.

May 20. Much snow on the Blue mountains, 25 miles off.

A. m.
7 00 a. m. air in shade 56.
10 00 " do. 66.
12 00 noon do. 74.5, ground 105.
2 00 p. m. do. 109.
4 00 " air in shade 79, water 58, wet bulb 79°.
7 00 " do. 63.

May 21. 8 00 a. m. do. 56. do. 48.5.
9 00 " do. 69.
10 30 " do. 77.
Noon do. 83.5.
1 00 p. m. water 57.5.
2 00 " do. 83.5.

	Bar Green No. 1273.	Att.	Det.	Water.	Wet bulb.	Temp. of soil 5.5 below surface.
2 40 p. m.	29.141	89.4	89.8			
4 00 "			83.5			
5 00 "			82.6			54.5
6 00 "			79.0	58.2		
6 15 "					63.5	
7 50 "	29.051	71.5	65.9			
9 30 "			57.5			

			Bar.	Att.	Det.	Wet bulb.	Water.	
May 22.	6 00 a. m.				66.5	62.5	50.0	
	8 40 "				77.3			
	8 50 "		28.970	78	77			
	11 45 "				81			
	1 30 p. m.				84.5		57.0	
	2 15 "				79.0			air in shade near the water.
	30 "				84.5			do. in the observatory.
		K.	28.854	84.7	84.3			
		W.	848	67.0	84.7			
	2 45	K.	852	85.5	85.5			
	3 20				83.5			air in shade near the water.
	3 30							101.5 ground, and 109 manure on the ground.

3 55 p. m. water 59.7
6 00 " do 57.0, air in shade near the water 73.
6 45 " wet bulb 56.3
7 00 " air in shade near the water 70.5
8 0 " do do 63.3
9 05 " Bar. 28.840, att 60.7, det 58.3
9 15 " " 845, " 60.6, " 58.2

May 23. 6 30 a. m. Air in shade 46, water 46.5, ground 51.
8 30 " Bar 29.097 K, att 54.5, det 56.1
8 35 " " 100 W, " 54.0, " 55.5
11 00 " Sun 62.5, shade 58, water 50, wet bulb 45.7

2 30 p. m.	Bar. 29.118,	att 65.7,	air 64.7	W.SW. 4, cloudy.
2 40 "	" 119,	" 68.0,	" 63.3	
2 50 "	" 116,	" 65.2,	" 67.0	
3 00 "	" 108,	" 67.0,	" 66.8	

1859.	h. m.	
May 23.	4 00 p. m.	Bar. 29.100, att. 59.7, det. 59.5, W.SW. 5, cloudy 0.8.
	4 20 "	" 100, " 60.5. " 60.0, SW. 6, cloudy 0.9.
	5 43 "	Air 55, water 51, wet bulb 46.
	6 15 "	Bar. 29.136, att. 57.3, det. 57.0, wet bulb 46.2, after a slight rain shower of about 5m., [clearing off, SW. 4, clouds 0.6.
	9 55 "	Bar. 29.205 K. att. 49.5, det 48.8.
	10 00 "	" 211 W, " 49.8, " 49.8, W. by N. 4, clouds 0.7.
	10 45 "	" 225 K, " 47.4, " 47.0.
		" 218 W.
May 24.	8 15 a. m.	Bar. 29.395 W, att. 53.5, det. 59.3.
	8 30 "	" 402 K, " 58.5, " 61.0.
	8 45 "	" 408 K, " 59.8, " 63.0, water 46, SW. 3, clouds 0.4.
	9 50 "	Dry bulb 54, wet 43.7, W. 3, clouds 0.3.
	10 00 "	Bar. 29.423 K, att. 66.7.
	Noon.	" 410 W, " 69.6, det. 72.0.
	0 30 "	" 428 W, " 71.0, " 70.7.
	0 35 "	" 436 K, " 70.4, dry 70.5, wet 52, W.SW. 3, clouds 0.4.
	2 21 "	" 424 K, " 68.3, det. 64.0.
	2 31 "	" 414 K, " 68.4, " 68.1.
	2 40 "	" 410 W, " 67.5, " 68.0, dry bulb 65, wet bulb 49.
		" 404 K, " 67.5, " 67.6.
	4 10 p. m.	" 403 W, " 67.5, " 67.2, wet bulb 50.3, S. by E. 1, clouds 0.5. Dark thunder cloud on the NW. horizon, drawing towards the westward and southward. A few drops of rain followed it.
	5 05 "	Bar. 29.410 K, att 67.0, det. 71.0, W.NW. 1, clouds 0.1.
	7 45 "	" 420 K, " 58.0, " 58.2, S.SE. 1, clouds 0.3. Immediately after sundown, wet 46.0.
May 25.	7 00 a. m.	Bar. 29.544, att. 57.5, det. 59.2, inside the observatory dry 61, wet 51. outside the observatory dry 56, wet 46.
	8 20 "	" 559, " 68.0, " 72.5.
	9 45 "	" 560, " 72.3. " 75.7, on creek water 48.3, dry 63.5, wet 48.6. in observatory dry 70.0, wet 57.5.
	10 40 "	Air outside 67.5, ground 118.5.
	10 55 "	Bar. 29.556, att. 73.5, det 78.0, wet 64.5.
	11 20 "	" 548, " 75.5, " 81.0.
	11 30 "	In chron. basket 79.
	1 00 p. m.	" 508, " 76.0.
	2 00 "	" 494, " 75.6.
	4 20 "	" 467, " 76.2.
	5 45 "	" 449, " 75.2, dry 69, wet 55.
	8 00 "	" 384, " 58.0, det. 56.5.
	10 00 "	A fine meteor on the southern horizon.

Observations for temperature on the ground, and 1 and 4 feet above it.

Date	Hour.	Soil.	Air at surface.	1 foot above.	4 feet above.	Remarks.
1859.	h. m.	°	°	°	°	
May 25	1 40 P. M.	124	88	74.7	70.5	
	2 15 "	122	88	75.3	70.5	
	3 45 "	112	82	76.0	72.0	
	4 20 "	100	79	74.0	70.4	
	5 15 "	89	74	73.0	70.5	
	7 40 "	60	55.5	56.8	56.8	E. 2.

NOTE.—Frequently whirlwinds in the valley, especially on the table land upon which the fort is situate raise a column of dust from 50 to 150 feet high.

METEOROLOGICAL.

NEW FORT WALLA-WALLA.

Date.		Aneroid.	Attached.	Barometer.	Attached.	Detached, No. 1.	Dry, No. 1.	Wet, No. 1.	Black.	Naked.	Mill creek water, No. 1.	Soil at ground No. 3.	Air at ½ in. above, No. 3.	Air 1 foot above, No. 2.	Air 4 feet abov No. 1.	Rain.	Wind, clouds, and remarks.
1859.	h. m.			in.													
May 26,	2 15 A.M.	....	....	29.346	46.0		....	....	....	....	....	....	....	....	....	....	
	8 00	....	....	29.378	70.8	75.5	....	....	....	....	49.5	....	....	....	....	....	In Observatory; dry 80°; wet 67°.
	8 30	....	....	....			71.0	58.0	....	....		108 0	89.0	75.5	71.5	....	
	10 00	....	....	29.372	78.7	74.7	75.8	56.5	....	....	50.5	120 0	91.0	78.0	76 0	....	
	Noon.	....	....	29 320	85.6	80.5	81.5	60.2	....	....	....	125 0	99 0	88 0	81.5	....	NE. 2; clouds 0.3.
	2 00 P.M.	....	....	29.394	87.0	83.0	83.2	65 5	....	....	59.0	123.5	91.3	86.0	83.2	....	
	3 50	....	....	29.256	....	....	....	....	....	....	....	....	....		....	....	
	4 07	....	....	29 228	83.4	81.2	83.5	62.9	....	....	....	111.7	90.0	87.5	83.5	....	NE. 1; clear.
	7 45	....	....	29.150	67.0	68.6	68.6	54.0	....	....	56.0	64.0	61.7	63.5	68.6	....	S SE. 1; clouds 0.1.
May 27,	0 10 A.M.	....	....	29.064	56.5	57.0	....	....	....	....	....	....	....	....	....	....	
	7 00	....	....	29.109	74 0	...	....	....	....	....	....	....	....	....	....	....	
	7 45	....	....	29.108	79.5	70 3	73 8	58.3	....	....	48.5	98 0	83.0	76.0	72.0	....	W. 1; clear.
	10 00	....	....	29.118	90.5	82.0	83 0	64 2	....	....	....	133 0	89 5	87 0	83.5	....	W.-W 1; clear.
	0 30 P.M.	....	....	29.061	92 5	87.0	90.0	67 0	....	....	....	133 0	109.0	92 0	90 0	....	NE 1; clear.
	2 40	....	....	29 007	92.0	91 0	94.0	66.0	....	....	61.2	130.5	104 0	98 0	94 0	....	NE. 1; clear
	4 45	....	....	28.918	90.7	88.0	89.0	62.5	....	....	....	102.0	99.0	91.0	89.5	....	NE. 2; clouds 0.1.
	7 10	....	....	28.736	78.7	79 0	78.0	61.2	....	....	60.5	78 0	76 0	77.8	79.3	....	NE 2; clouds 0.5.
	9 15	....	....	28 852	72.0	70 5	....	....	....	....	....	....	....	....	....	....	W. 3; clouds 0.9.
May 28,	0 05 A.M.	....	....	28.928	63.0	61 3	....	....	....	....	....	....	....	....	....	....	S. 3; clouds 0.1.
	2 30	....	....	28 940	60 0	60 5	....	....	....	....	....	....	....	....	....	....	
	7 00	....	....	28.888	62.0	60.5	60 0	50.0	....	....	50 0	64 0	60.5	60 5	60 0	....	S. 1; clouds 1.0.
	9 25	....	....	29 015	63.7	61 8	61.8	51 9	....	....	50.0	70.0	65.0	62.0	61 8	....	S. 2; few drops of rain.
	11 40	....	....	29.024	75.2	69.0	69.0	56.5	....	....	....	96 0	89 0	72.5	70.0	....	S. 2; nimb. 1.0.
	0 10 P.M.	....	....	29.008	73 0	....	....	....	....	....	....	....	....		....	....	
	3 08	....	....	28.999	81 0	62.5	62.0	55 5	....	....	....	67.0	62 0	63 5	62.0	...	S 2; nimb 1 0.
	5 19	....	....	28 988	60.5	....	60.5	57.5	....	....	53.0	59.0	55.0	56.0	55.0	0.01	SW. 2; nimb. 0.9.
	11 48	....	....	29.024	50.5	50 0	....		...	....	....	....	....	....		....	Nimb. 0.2.
May 29,	7 00 A.M.	....	....	29 080	54.7	53.7	53 8	49.5	....	....	47.7	57.0	55.0	54.7	54.7	....	S.SW. 3; nimb. 0.9.
	8 10	....	....	29.100	58.5	56.5	56.4	51 3	....	....	....	64.0	60.5	58 5	56.5	....	S SW. 3; nimb. 0.8.
	9 30	29.190	72.0	29.150	70 0	60.0	...	....	....	....	....	....	64 0	62.0	59.0	....	SW 4; nimb. 0.9.
	10 00	29.205	69.0	29.140	66 0	65.0	60.2	51.8	....	....	....	....	....	....	60.0	....	Few drops of rain.
	11 00	29 202	71.0	29.128	68.5	....	....	....	....	....	....	....	....	....	....	....	
	0 05 P.M.	29.205	70.7	29.120	70.5	....	64.5	52.7	....	....	53.0	80.0	71 0	65.0	63.5	....	SW. 5; nimb. cum. 0.5.
	2 00	29.198	72 0	29.115	71.5	67.0	69.5	56.0	....	....	....	81.5	76.5	69.5	67 0	....	SW. 5; cum. 0 6.
	2 40	29.196	74.5	29.108	73.0	....	....	....	....	....	....	....	....	....	....	....	

Meteorological Observations—Continued.

NEW FORT WALLA-WALLA.

Date.		Aneroid.	Attached.	Barometer.	Attached.	Detached, No. 1.	Dry, No. 1.	Wet, No. 1.	Black.	Naked.	Mill creek water, No. 1.	Soil at ground, No. 3.	Air at ½ in. above, No. 3.	Air 1 foot above, No. 3.	Air 4 feet above, No. 1.	Rain.	Wind, clouds, and remarks.
1859.	h. m.			in.													
May 29,	5 00 P. M.	29.175	74.0	29.078	70.0												
	6 00					67.0	68.0	51.2			55.0	77.0	71.0	70.5	67.5		W.SW. 5; cum. 0.1.
	7 30	29.156	64.0	29.057	63.0	59.0	59.1	49.0				58.0	58.0	59.5	59.5		W.SW. 4; cum. 0.1.
	10 00	29.176	68.0	29.062	58.0		52.7	47.5									S. 5; cum. 0.9.
May 30,	6 00 A. M.	29.105	54.0	29.044	54.5							59.0	54.5	53.5	51.0		SW. 1; cum. 0.9.
	7 30	29.115	59.0	29.042	59.4												
	8 15	29.130	57.0	29.056	56.0												
	8 30						52.2	46.5				57.0	53.7	53.0	51.0		SW. 1; nimb. 1.0
	10 00	29.145	58.0	29.063	57.4		56.0	51.7				61.0	53.7	54.5	54.5	0.01	SW. 2; nimb. 0.9; raining.
	0 30 P. M.	29.115	65.0	29.038	60.5		59.0	48.5				72.0	66.0	62.0	59.5		S. 4; nimb. 0.9; raining.
	1 00	29.115	60.0	29.028	58.5		57.5	51.6								0.01	SW. 5; thunder; raining.
	2 00																SW. 7.
	9 45	29.140	63.0	29.069	62.7												
	6 30	29.202		29.114	58.5		52.3	43.5									SW. 6; clouds 0.4.
	7 30						54.3	45.0			49.6						
	11 25	29.965	48.5	28.178	47.0												
May 31,	1 08 A. M.	29.275	49.5	29.194	46.5												
	6 30	29.307	45.6	29.259	45.2												
	6 45						44.2	39.7			45.5	46.0	46.0	46.3	45.2		SW. 3; nimb. 0.3.
	7 30	29.355	55.5	29.300	55.8												
	7 45						49.7	42.8				51.0	51.0	52.0	49.5		W.SW. 4; nimb. 0.3.
	8 20	29.360	52.0	29.314	60.3												
	10 30	29.415	63.0	29.338	64.5		60.3	48.1	68.5	64.5		80.0	71.0	63.0	58.7		W.SW. 4; nimb. 0.4.
	Noon.	29.447	65.0	29.330	62.5		64.5	48.5	72.0	66.0		90.0	79.0	68.0	64.5		W.SW. 4; cum. 0.3.
	4 20 P. M.					63.0	65.2	50.0	73.0	65.2		76.0	67.5	65.5	64.0		W.SW. 3; cum. 0.3.
	5 15	29.443	69.0	29.359	68.0												Max 70.2.
	6 30	29.450	67.0	29.37[illegible]	64.5							67.0	66.0	65.0	63.3		W.SW. 2; cum. 0.1.
	10 00			29.378	4[illegible].0												Clear and calm.
June 1,	1 08 A. M.	29.465	43.0	29.384	43.0												Min 40°.
	2 40	29.45[illegible]	40.5	29.372	40.0												
	7 10			29.411	66.0												
	7 40					54.0	61.0	50.8	73.5	66.4		85.0	83.0	69.5	60.3		N.NE. 1; clear.
	9 12	29.450	63.0	29.399	75.5	57.0	64.0	50.0	74.5	66.8	48.5	98.0	83.0	71.0	64.0		N.NW. 1; clear.
	10 20	29.440	69.5	29.400	79.5	67.5	71.3	56.7	75.0	69.0		114.0	84.5	74.0	69.7		W.NW. 2; clear.
	0 [illegible] P. M.	[illegible]	75.5	[illegible]	80.3	73.6	73.0	54.0	81.5	75.5		112.0	89.0	77.0	75.0		NE. 2; clear. Saw a cylinder of dust 300 feet high.

	2 00	29.372	79.6	29.314	70.0	74.0	72.0	55.0	88.0	80.5	57.5	130.0	85.0	83.0	79.8	.....	NE. 2; clear.
	4 05	29.315	81.0	29.270	79 6	76.8	78.7	56.7	84.5	80.5	59.5	90.0	83.0	79.0	81.0	......	NE. 3; clear.
	6 35	29.295	74.0	29.236	74.0	.....	72.5	55.0	.....	.. ..	....	71.0	70.5	72.0	72.5	......	N NE 4; clear.
	10 15	29.260	55 0	29.164	54.8	......	..	.....	......	.....	....	....	....	.....	.....	......	Max 83.6.
June 2,	6 07 A. M.	29.223	54.5	29 198	59.3	54.8	55 0	45.2	64 0	60 5	47 5	60.0	59.0	56.5	55 0	....	SW. 1; cirrus 0.1.
	8 47	29 280	64.5	29.245	66.0	71.0	71.0	56.7	71.2	66 0	49 5	66 0	78.5	69 0	66.0	....	SW. 1; cirrus 0.4.
	0 45 P. M.	29 245	83 5	29.218	85.5	76.5	83.2	69.5	86.0	83.5	56 0	112 0	93.5	85.5	82.0	.....	N 1; cirrus 0.5.
	4 00	29.175	86.0	29. 21	86.5	87 0	84.7	67.6	89 0	86 5	59.5	94.5	88.0	87.0	86 0	.....	N NE 3; cirrus 0 5.
	7 00	29.065	76.0	29 067	77.0	72.7	73.1	61.5	74.0	74.0	56.6	73.0	71.0	73.0	73.5	...	N NE 1; cirrus 0.5.
June 3,	0 45 A. M.	29 020	55.0	28.982	56 0	......	.....	......	....	.....	...	......	.. ....	...	....	......	Max. 89.5.
	6 50	29.075	72.0	29.012	71.0	68.0	70.2	62.5	78.5	75.0	51.0	84.0	83.0	74.0	72.5	....	SW. 1; nimb. stra. 0.4.
	7 30	.....	......	.....	....											....	Max 92.0.
	8 30	29.135	79.2	29.095	78.0	68 5	....	....		.....	...	....	....		......	.....	E. 1; cir. stra. 0.4.
	2 00 P. M.	29.120	93 5	29 080	90.0	78 8	82.1	68 0	99 5	91.6	57.5	115.0	86.5	90.5	90 5	.....	SE. 2; nimb. stra. 0.4.
	7 00	29 020	85.0	28.962	84.0	80.5	81 5	66.2	82.7	81.7	59.5	83.5	82.5	82 5	81.5	.....	Setting in for rain.
	7 40	28.985	76.0	28.925	78.7	....	....	....	......	....	....	....	....	......	.....	.....	N. 3; clearing up.
	8 30	28.950	77 0	28.898	77.5	....	...	......	....	......	...	....	....	......	..	.....	SW. 5; cum. 0 1.
June 4,	7 15 A. M.	29.115	71.7	29 074	71.7	66 0	65.7	52.8	....	....	51 5	78.0	74.0	69.5	67.5	...	SW. 5; stra. 0.5.
	11 00	29.260	75 0	29.224	74.3	68 7	71.1	56 3	....	....	56 0	88.0	77.0	72.5	69.5	....	W 6; stra 0 5.
	12 00	29.295	73.5	29.260	73.5	72.0	69.5	55.0	..	......	....	......	77.0	73.8	69 5	.....	W.SW. 6; stra 0.3; dust.
	2 00 P. M.	29.350	77.0	29.314	76 7	74.5	73.2	51.2	77.0	73 0	59 2	104.0	81.0	75.5	73.0	...	W.SW. 5; stra 3.
	4 00	29.365	72 5	29.328	72.0	68 5	70 0	53.7	75.6	71.5	59.0	87 0	77.5	74.3	71.5	....	W 4; cum. 0.1.
	6 30	29.367	70 0	29.356	68.7	66 5	67.0	51.3	....	...	57.8	68.0	68 0	68 5	67.5	....	W. 1; clear.
	10 15	29.435	50 5	29 400	52.0		.	..	....	....		....	45.0	47 0	47.0	....	Calm; clear.
June 5,	6 00 A. M.	29.425	58.0	29 398	56 0	50.8	....	46.7	.....	...	47.0	67.0	59.0	58 0	56.5	......	W 1; clear.
	7 00	29.460	68.0	29.436	66 7	55.5	....	......	....	.	.				..	....	NW. 1; clear.
	10 45	29.404	74.5	29 358	73 0	63 7	64 8	52.9	79.5	74 0	51.3	112.0	84 5	71.5	68 6	.....	N 3; clear.
	3 00 P. M.	29.235	78.0	29.186	77.0	77 0	77.5	55.7	81 0	77.5	59.1	120.0	88 0	82.0	77 8	.....	N.NE. 3; clear.
	5 00	29.170	77.5	29 136	76 5	74 2	75.5	53.7	80.0	76 7	59.5	90 0	89.0	79.0	76 7	....	Calm; 0 4.
	11 45	29.065	52 0	29.036	52.0			......	....	.....	....	.	..	......	.....	....	[illegible] 2; 0 6.
June 6,	6 15 A. M.	29 157	57.0	29.136	56.5	56.0	56.4	48.2	...	.	47 8	59.0	56 8	57.0	56 3	....	W. 2; 0.1.
	9 15	29 255	73.7	29 200	73 0	68.5	70 6	53.7	76 0	71 0	52.7	91 0	83 0	73 5	70.6	....	NW. 1; 0.1; max. 78°.
	0 15 P. M.	29.262	77.1	29.230	75.8	72.5	73.7	55.2	81.5	77.0	58.0	114.0	89.0	78.0	75.3	....	W. 2; 0 1.
	3 45	29 260	77.2	29 222	76.7	76.5	77.3	57.9	81.0	78.0	61.5	102.0	84 0	78 5	75 0	......	SW. 2; 0.2.
	6 35	29.260	70 0	29 230	69 8	68 0	68.7	54.5	......	...	59 3	72.4	68.8	69.3	69 3	...	SW 2; clear.
	11 35	29 310	55.0	29.290	55.5		....	..	....	......		.... .	....	......	......	.....	Calm; cir. 0.3.
June 7,	6 45 A. M.	29 404	69 2	29.366	67.0	61.5	63.7	52.3	73.5	69.3	49.0	72 0	72 0	64 6	63 5	...	SW. 2; cir 0.3.
	8 30	29.457	77.0	29.427	74.5	..	66.5	52.3	73.5	67 6		87.0	79.0	69.0	67.5	.....	SW. 1; cum. 0.1; max. 83°.
	2 30 P. M.	29 457	88 5	29.412	87.0	78.0	79.0	57.5	85.5	80.8	59.5	112.0	96 0	83.5	80 0	....	SW. 0.5; cum 0.1.
	4 30	29.436	90.5	29.378	85.3	71.5	77.0	59.5	87.0	84 0	60.7	105 0	90.7	85.0	83 0	......	NW. 1; cum. 0.1.
	6 30	29.403	80.5	29.352	79 0	64.0	72.0	58.4	83.0	80.0	60.1	83.0	79 0	80 0	80.0	......	E. 1; clear.
	11 30	29.350	57.0	29.315	58.0	....	56.9	48.5	....	....	...	....	....	54.0	56.0	....	S. 1; clear.
June 8,	7 00 A. M.	29.430	76 5	29.398	78.0	66.5	67.2	55.0	76.0	70 8	50.0	83.0	79.5	71.0	68.0	....	W.SW. 2; clear.
	11 15	29 425	91.7	29.384	88 8	81.6	83.5	63.5	92.5	88.0	57.0	133.0	98.0	89.5	85.5	....	NE. 3; clear; max. 94°.2.
	3 30 P. M.	29.327	9 .2	29 288	90.5	88 5	91.0	65.7	96.7	93.0	64 0	125.0	102.6	94 5	93.5	....	NE 3; clear.
	7 00	29.243	87 0	29.204	85.0	85.5	85.5	63.2	...	...	63.5	85.0	84.0	85.5	85.5	.....	N. 1; clear. A fine northern light reaching from the horizon to the Polar star; Capella in the centre.
	11 45	29.143	63.0	29.106	63.7	....	......	....	......	.....	...	....	....	....	......	....	
June 9,	8 00 A. M.	29.187	82 5	29.148	78 7	70 5	74 9	61.5	.....	.....	52.8	90.0	79 0	77.0	73 7	....	NW. 1; cir. 0.2.
	9 00	29.197	87.5	29.150	86.0	76.5	79.7	64.3	91.4	83.5	54 5	111.0	99.0	86.0	83.0	.....	NW. 1; cir 0.2.
	Noon.	29.185	99.5	29.116	93.5	85.0	89.5	67.0	100.8	95.5	59.0	134 0	109.0	96.5	92.5	..	NW. 1; cir. 0.2. At noon a circle of 22° diameter around the sun.

Meteorological Observations—Continued.

NEW FORT WALLA-WALLA.

Date.	Aneroid.	Attached.	Barometer.	Attached.	Detached, No. 1.	Dry, No. 1.	Wet, No. 1.	Black.	Naked.	Mill creek water, No. 1.	Soil at ground, No. 3.	Air at ½ in. above, No. 3.	Air 1 foot above, No. 3.	Air 4 feet above, No. 3.	Rain.	Wind, clouds, and remarks.
1859. A. m.			in.													
June 9, 2 00 P. M.	29.147	103.0	29.098	98.0	95.5	98.9	69.5	104.5	98.8	64.5	137.0	112.0	102.0	100.0	......	NW 9; cir. 0.2; max 104°.
4 40	29.045	96.0	29.004	94.5	91.0	91.0	71.5	......	....	66.5	......	98.0	...	96.5	......	NE 3; cir cum 0.7; sheet lightning at S.SW.
7 45	29.020	84.0	28.980	83.0	...	....	......	....	....	......	84.0	85.0	85.0	85.0	.....	S. 3; cir cum 1.0; sheet lightning at W.
June 10, 0 15 A. M.	29.036	72.0	29.002	74.0	...	73.5	60.5	...	......	....	......	......	..	73.5	......	S. 1; nimb 0.9.
6 30	29.030	75.2	29.006	75.5	73.0	74.7	64.0	77.5	76.7	55.7	78.5	78.0	76.5	74.5	......	SW. 2; stra 0.9.
8 15	29.062	78.2	29.011	80.0		77.3	63.5	86.3	85.5	.. ...	85.0	81.3	79.0	77.0	......	S. 3; stra 0.8.
11 15	29.090	87.2	29.036	86.0	84.0	84.4	65.3	96.5	93.5	60.5	103.0	92.0	86.5	84.3	.....	SW. 4; stra 0.6.
4 00 P. M.	29.040	95.0	28.957	91.5	89.5	90.3	63.3	.....	......	65.0	106.0	98.0	93.0	91.0	.. .	W.SW. 4; cir. 0.1; max. 93°.
6 00	28.995	87.0	28.954	86.5	83.0	83.0	62.0	..	....	66.0	91.0	85.0	88.0	87.0	......	SW. 4; cir 0.2.
June 11, 1 00 A. M.	29.080	59.5	29.046	61.0	64.6	60.0	56.0	....	....	.....	......	...	....		....	S. 1; cir 0.1.
7 00	29.100	65.5	29.066	66.5	71.4	65.7	57.4	....		51.8	73.0	70.5	67.5	66.0	....	SW. 3; stra 0.8.
9 45	29.142	77.0	29.100	76.5	72.5	73.3	58.1	78.5	74.5	54.3	91.7	84.0	77.5	75.0	....	SW. 3; stra 0.8.
Noon.	29.145	81.5	29.098	79.5	82.7	74.5	59.6	...	...	57.0	92.5	85.5	......	76.0	......	SW. 3; stra 0.7.
4 00 P. M.	29.095	87.0	29.034	82.0	70.3	83.4	61.3	91.5	86.0	61.0	99.0	92.8	....	84.5	....	S.SW. 2; stra 0.1.
7 00	29.049	71.0	29.012	72.0	....	74.4	57.5	..	....	60.7	67.0	65.0	......	68.5	......	SW. 1; stra 0.1.
10 00	29.067	62.0	29.044	63.7	.. ..	...	...	....	....	.....	......	......	....	......	....	SW. 1; stra 0.2.
June 12, 0 15 A. M.	29.065	58.0	29.032	59.0	...	..	..	......	....	.....	....	...	....		....	S.SW. 1; stra 0.3.
4 00	29.075	56.5	29.040	57.0	57.0	57.5	51.2	....	....	52.0	56.0	55.5	....	58.0	.....	S.SW. 1; stra. 0.7.
4 30	29.080	58.3	29.048	57.5	....	....	......	....	.	......	....	....	.....	......	....	

Barometric trip to a spur of the Blue Mountains.

	h. m.		
June 13.	4 40 A. M.	Started with McKnight. Barometer Green No. 1273, and thermometer No. 3.	
	4 45	Crossed Mill creek,	Tributaries to the Walla-Walla river.
	5 05	Crossed second creek,	
	10	Crossed third creek,	
	25	Crossed fourth creek,	
	42	Crossed fifth creek,	
	51	Crossed sixth creek,	
	6 07	Spring; water 53.7, air 62.2, dry 63.0, wet 56.0.	
	25	Foot of Blue mountains.	
	40	Barometer 28.819, att. 63.5, det. 63.0.	
	7 00	Barometer 28.852, att. 63.1, det. 64.0, S. 1, cir. stra. 0.9.	
	30	Started to Horster's house; cistern of barometer 1 foot above cealing.	
	8 15	Barometer 28.606, att. 65.7, det. 64.2.	
	50	Barometer 28.600, att. 65.5, det. 64.5, wet 55.2.	
		The temperatures of three springs near by are 56°, 64°, 58°.	
	55	Went up the valley of a small creek.	
	9 05	Temperature of spring water 54.6.	
	15	Temperature of spring water 53.4.	
	25	Temperature of spring water 54.0.	
	30	Temperature of air 59.3, S. 4.	
	10 00	Pine tree.	
	05	Barometer 27.327, att. 62.0, det. 60.7, wet 52.5.	
	11 00	Barometer 26.574, att. 65.5, det. 59.0, wet 51.5.	
		16 feet below summit of spur, lower limit of snow:	
	45	Barometer 26.185, att. 61.0, det. 57.7; raining.	
	12 00	Barometer 26.185, att. 59.3, det. 59.3, wet 47.3.	
		On creek passing Mr. Russel's farm, about 600 yards below, and 8 feet above water:	
	2 00 P. M.	Barometer 28.512, att. 73.5, det. 71.7, wet 60.2, water 55, S SW. 4, cum. stra. 0.4.	
		On the bridge below, 2 feet above bridge, or 5 feet above water:	
	3 00	Barometer 28.702, att. 75.2, det. 73.5, wet 61.0, water 57, S.SW. 3, cum. 0.3.	
		Crossing Mill creek, 3 miles above the fort, 2½ feet above water:	
	4 00	Barometer 28.934, att. 77.0, det. 75.5, wet 64.0, water 58.3, SW. 3.	
	5 10	Returned to the observatory.	
	5 15	Barometer 28.012, att. 74.3.	

Meteorological observations—Continued.

NEW FORT WALLA-WALLA.

Date.		Aneroid.	Attached.	Barometer.	Attached.	Detached.	Temperatures in open air.								Shade.		Mill creek water.	Rain.	Wind.	Clouds.	Evaporation.
							Dry.	Wet.	Black.	Naked.	Soil at ground.	Air at ground.	Air at 1 foot.	Air at 4 feet.	Dry.	Wet.					
1859	A. m.		°		°	°	°	°	°	°	°	°	°	°	°	°	°				
June 12,	9 00 A. M	29.143	74.3	....	....	71.0	70.7	57.7	72.0	71.0	83.0	73.7	71.2	71.0	....	....	52.5	....	SW 2	Stra. and N. 0.9	....
	11 00	29.140	72.0	....	....	71.0	70.8	57.3	72.5	71.0	83.5	73.5	71.0	71.0	....	....	54.2	....	W.SW. 2	Nimb 1 0	....
	12 00	29.131	71.0	....	....	....	71.0	58.8	73.0	71.2	84.0	75.0	71.6	71.0	....	....	.	....	SW. 1	C. S N 0.9	....
	1 00 P. M.	29.123	75.0	....	....	....	74.4	62.0	79.5	75.5	92.0	81.5	76.3	74.7	....	....	56.0	....	SW. 3	C S. N 0.8	....
	2 05	29.108	78.5	....	....	....	78.0	64.2	....	....	....	....	..	....	....	....	....	....	SW. 3	C. S. N. 0.3	....
	3 22	29.086	79.0	....	..	....	77.2	63.5	....	..	....	....	....	.	....	....	.	....	SW 3	C. S. N 0.2	....
	4 00	29.068	80.0	....	.	..	78.2	64.0	84.0	81.2	99.0	87.0	80.5	79.0	....	....	57.7	....	SW 3.5	C S. N. 0.2	....
	6 15	29.123	73.5	29.012	74.3	72.5	73.2	61.5	74.0	74.0	76.0	75.0	74.0	74.0	....	....	59.0	....	W.SW. 5	C. N. 0 4	....
	9 40	29.062	63.8	29.008	64.8	....	...	....	....	....	....	....	....	....	....	....	....	...	....	....	....
June 13,	0 00 A. M.	29.088	61.0	29.058	61.0	...	....	.	....	....	....	....	....	....	....	....	..	....	....	....	....
	7 57	29.158	65.0	29.112	61.5	59.5	58.5	51.5	....	....	72.0	63.5	60.3	59 4	....	....	51.0	....	SW 4	C N. 0.8	....
	10 12	29.167	68.4	29.132	68.0	....	....	....	....	....	....	....	....	....	....	....	..	....	SW 4	C N. 0.6	....
	11 00	29.168	77.0	29.124	75.7	68.0	67.0	56.4	74.5	70.0	97.0	75.5	70.3	68.0	....	....	54.0	....	SW. 4.5	C 0.3	....
	0 30 P. M.	29.150	76.0	29.108	74.6	71.5	71.5	55.0	....	....	....	....	....	....	....	....	56.3	....	SW 5	C. 0.3	....
	5 00	29.130	78.2	29.086	78.0	72.3	72.3	56.7	....	....	....	....	....	....	....	....	61.0	....	W 2–3	C. 0 1	....
	6 45	29.122	67.0	29.082	67.7	65.2	66.6	54.7	....	....	71.7	70.0	69.0	68.0	....	....	59.5	....	W.SW. 4	C. 0.2	....
	12 00	29.178	49.0	29.147	51.3	....	....	....	....	....	....	....	....	....	....	....	...	....	S. 1	Clear	....
June 14,	1 30 A. M.	29.180	48.0	29.148	48.0	....	....	....	....	....	....	....	....	....	....	....	....	....	S. 1	Clear	....
	6 00	29.235	59.0	29.217	55.7	52.8	53.4	47.9	..	....	58.5	60.0	57.0	54.0	....	....	48.5	....	S.SW 1	Stra. 0 4	....
	9 10	29.257	71.3	29.241	71.5	63.0	62.4	52.5	70.7	67.0	103.0	79.0	69.5	66.0	....	....	51.0	....	W. 1	C. stra. 0.1	....
	11 00	29.266	76.4	29.234	77.3	....	67.3	55.5	73.0	70.0	120.5	81.5	71.3	67.5	....	....	54.7	....	NE. 1	C. stra. 0.1	....
	2 10 P. M.	29.235	82.3	29.186	82.3	....	77.9	60.8	84.5	79.5	117.5	91.7	80.6	76.7	....	....	61.0	....	N 1	C. stra. 0 1	....
	5 05	29.162	79.4	29.108	78.8	....	74.6	59.4	80.6	78.2	94.0	81.0	78.0	76.4	....	....	63.3	....	W 1	C. N. 0.9	....
	7 20	29.192	71.0	29.080	71.3	....	68.3	57.2	71.0	71.0	69.0	70.0	69.5	70.5	....	....	61.0	....	Calm	C N. 1 0	....
	12 00	29.066	61.3	29.044	61.7	....	....	....	....	....	....	....	....	....	....	....		....	E. var. 1	C. N. 1 0	....
June 15,	7 00 A. M.	29.065	68.0	29.037	66.0	64.5	68.1	55.4	....	....	70.5	67.5	....	60.0	....	....	52.5	...	S. 1	N. S. 1 0	....
	9 15	29.122	70.0	29.070	70.0	....	70.0	62.0	....	....	....	71.5	69.8	69.8	...	....		...	SW. var. 1	N. S. 1.0*	....
	11 00	29.140	76.0	29.091	73.7	...	74.5	57.9	.	.	87.0	77.0	74.0	72.0	....	....	53.5	....	W.SW 2–3	N. C. 1.0	....
	0 50 P. M.	29.156	72.0	29.106	72.0	69.5	70.0	58.4	68.5	70.0	77.0	72.0	70.0	69.0		...	54.3		W 0–1	N. 1.0†	....
	4 05	29.158	66.2	29.136	65.7	....	65.0	63.0	66.8	66.6	66.5	66.2	65.0	65.0	64.9	62.8	55.0	0.04	W. 1	S. N. 0 9	....
	7 22	29.184	65.3	29.152	65.5	....	66.5	61.0	66.5	66.6	64.0	63.5	64.5	66.0	63.8	59.1	54.5	....	S SW. 1	S. N. 1.0	....
	11 00	29.200	64.0	29.154	64.0	....	....	....	....	....	....	....	....	....	....	....	....	....	Calm	S. N. 1.0	....
June 16,	0 55 A. M.	29.184	64.0	29.140	64.5	....	64.0	59.8	....	....	62.0	63.0	62.0	63.7	....	....	....	....	Calm	N. S. 1.0	....

	6 30	29.300	66.5	29.188	67.0	......	67.5	61.3	......	....	70.0	69.0	68.0	67.5	65.3	61.7	59.5	......	SW. 1	N. S. 0.9	......
	8 00	29.318	72.0	29.186	71.6	......	71.5	63.4	74.4	73.0	76.0	74.9	78.5	71.5	69.0	64.9	53.2	......	S. 1	N. S. 0.9	......
	10 00	29.308	86.5	29.203	86.5	......	81.5	70.5	87.0	82.5	118.0	90.0	84.0	81.5	79.0	70.3	55.3	......	W. 1	C. S. 0.8	‡194
	Noon.	29.230	88.3	29.192	88.7	......	86.5	70.7	90.5	88.0	114.0	95.5	89.0	86.0	81.0	71.7	57.5	......	SW 3	C. S. 0.5	94
	2 00 P. M.	29.218	93.0	29.168	91.7	......	90.0	71.5	93.7	92.3	106.0	96.5	91.7	89.9	80.7	74.0	61.5	......	W 3	Cum. 0.3	36
	4 00	29.184	90.0	29.134	89.8	......	88.8	67.5	92.0	90.0	107.0	94.1	90.7	89.3	[illegible]	69.5	63.5	......	W.SW. 3	Cum. 0.3	48
	6 50	29.153	87.0	29.115	87.5	......	77.0	59.0	77.8	77.2	76.2	77.3	75.7	77.0	76.4	61.0	62.3	......	SW. 2	Cum. 0.5	62
	11 30	29.162	64.0	29.116	64.0	......	......	..	...	..	......	......	...	...	......	......	......	......	SW. 1 *	Clear	......
June 17,	2 20 A. M.	29.15	59.0	29.118	59.7	......			..		..		......		.		..		S SW. 3	Clear	......
	8 00	29.245	76.0	29.200	75.5	......	65.5	56.0	73.0	68.5	87.0	73.0	68.0	65.0	65.3	56.4	53.0	......	SW. 3	Clear	76
	11 00	29.2[illegible]8	77.3	29.181	77.3	......	76.0	55.0	78.0	76.0	114.0	84.0	78.0	75.0	74.0	59.0	57.5	......	S.SW. 3	Clear	83
	1 00 P. M.	29.210	81.5	29.170	82.0	......	80.0	59.5	88.0	83.0	104.0	93.0	84.0	81.0	[illegible]	59.0	61.5	......	W NW. 1	Clear	88
	2 00	29.187	84.0	29.128	83.0	......	87.0	61.5	94.0	87.2	128.0	95.5	86.7	84.5	79.5	63.0	62.7	......	Calm	Clear	92
	5 50	29.198	84.5	29.093	84.5	......	85.0	57.3	94.0	86.0	101.0	90.0	87.0	85.0	78.2	62.5	64.0	......	Calm	Clear	160
	8 00	29.107	67.5	29.050	70.7	......	64.2	53.0	61.0	64.2	64.0	64.5	69.7	64.0	64.7	58.0	61.6	......	SE. 1	Clear	105
June 18,	1 45 A. M.	29.042	51.3	29.022	53.0	......		...	..	......	....	......	....	......	.	....	...	......	Calm	Clear	......
	3 50	29.050	50.2	29.024	51.0	......	49.0	42.9	50.0	50.3	45.0	45.5	46.5	48.0	46.5	44.6	50.7	......	S. 1	Clear	......
	7 30	29.150	74.0	29.122	75.0	......	73.0	55.9	76.4	72.0	97.0	....	....	73.5	66.5	54.7	51.7	......	SW. 1	Clear	......
	9 15	29.160	82.5	29.120	82.7	......	74.0	56.3	78.0	75.0	110.0	......	......	74.5	70.7	59.5	53.5	......	NW. 1	Clear	......
	11 00	29.166	85.7	29.118	84.6	......	78.5	59.3	80.0	77.8	131.0	91.6	80.0	76.3	74.0	61.5	56.7	......	S.SW. 1	Clear	‖36
	1 00 P. M.	29.157	89.0	29.102	89.0	......	84.0	59.5	92.0	87.0	136.0	101.0	88.0	86.0	83.0	61.5	61.0	......	E. 1	Clear	44
	2 45	29.193	93.0	29.076	93.0	......	90.0	65.3	99.5	94.0	128.0	104.0	95.7	91.7	88.7	63.5	65.0	......	Calm	Clear	48
	6 30	29.073	85.5	29.036	85.0	......	85.4	62.3	91.5	88.4	86.0	87.5	87.5	85.7	74.5	64.0	64.4	......	Calm	Clear	56
	8 20	29.025	67.5	28.9.7	69.2	......	66.5	54.2	67.2	67.5	66.5	67.0	66.2	67.0	67.0	61.0	62.0	.	SE. 1	Cum. stra. 0.1	62

*Light rain. †Rain commencing. ‡ dl=1-64 inch. ‖ [illegible]et.

NOTE.—The evaporation vessel is a cylindrical tin, 3¼ inches diameter, placed 5 feet above the ground.

Meteorological observations—Continued.

NEW FORT WALLA-WALLA.

Date.	Aneroid.	Attached.	Barometer, 1973.	Attached.	Barometer, 1975.	Attached.	Temperatures in open air.								Shade.		Mill creek water.	Wind.	Clouds.	Evaporation.
							Dry.	Wet.	Black.	Naked.	Soil at ground	Air at ¼ inch.	Air at 1 foot.	Air at 4 feet.	Dry.	Wet.				
1850. h m.		°		°		°	°	°	°	°	°	°	°	°	°	°	°			
June 19, 1 20 A. M.	29.030	60.5	28.994	61.5	....	......	.....	....	.....	.....	....	....	.....	.....	.....	.....	....	SW. 1	Clear	.....
4 07	29.065	50.3	29.024	59.0	....	.....	57.0	46.3	58.4	58.5	55.0	55.0	56.0	57.0	57.0	50.5	52.0	S.SW. 2	Clear	67
7 00	29.165	74.2	29.140	73.5	....	......	71.5	51.3	76.7	74.3	82.0	78.0	73.7	72.0	68.5	58.8	52.0	SW. 3	Clear	72
9 10	29.197	81.5	29.146	81.5	....	.....	76.5	59.0	83.5	80.2	103.0	86.0	79.0	76.5	75.5	64.7	54.8	S.SW. 5	Clear	78
11 12	29.216	86.3	29.163	85.7	....	....	74.0	60.2	...	......	105.0	[illegible]	86.6	80.8	79.8	65.0	58.0	S.SW. 4	Clear	82
12 17 P. M.	29.217	89.0	29.166	88.0	....	....	83.8	60.0	90.0	88.0	120.0	94.0	87.0	84.0	84.7	66.0	60.5	S.SW. 5	Clear	88-36
2 45	29.210	89.5	29.164	89.0	.....	....	88.3	61.0	91.3	87.8	121.0	104.0	92.0	88.7	86.7	60.0	64.5	S.SW. 4	Clear	44
7 15	29.200	76.0	29.156	77.0	29.146	77.8	75.0	55.0	76.7	75.7	75.0	74.0	74.5	74.8	69.8	60.5	62.8	S.SW. 1	Clear	60
11 40	29.240	59.5	29.226	60.5	29.222	61.0	.....	.	......	....	....	......		...	......	.	......	S.SE. 3	Clear	.....
June 20, 7 20 A. M.	29.392	74.5	29.351	75.0	29.332	76.0	68.5	54.0	76.5	71.8	87.0	79.0	73.0	68.5	64.7	58.5	51.8	S. 1	Clear	69
9 15	29.416	80.0	29.388	79.0	29.394	80.0	72.6	58.5	81.7	75.7	112.0	88.0	78.2	72.6	...	......	.....	SW. 1	Clear	72
0 20 P. M.	29.412	85.5	29.376	84.5	29.372	85.7	83.6	61.4	91.0	84.5	127.0	99.0	87.0	83.6	76.8	61.0	60.0	SW. 1	Clear	79
3 10	29.356	89.5	29.310	88.5	29.306	89.5	89.3	63.5	94.0	89.0	123.0	103.0	94.0	89.0	85.4	67.5	61.7	NE. 2	Clear	92
5 25	29.307	87.3	29.265	87.3	29.260	88.3	88.0	60.0	92.0	88.4	98.0	92.0	90.0	88.3	85.2	64.0	65.0	N. 3	Clear	102
8 45	29.255	67.5	29.224	67.5	29.212	68.5	65.2	51.5	65.5	66.0	66.0	62.0	64.0	65.5	66.5	58.5	63.0	NE. 2	Clear	112
June 21, 8 00 A. M.	29.287	73.8	29.242	73.7	29.248	74.5	72.5	59.0	76.0	73.5	96.0	83.0	75.5	70.5	67.0	57.7	52.7	SW. 1	Stra. 0.1	120
8 50	29.308	79.0	29.250	80.0	29.262	81.3	......	..	....	......	....	....	.....	......	74.4	......	.....	....	....	......
9 00	29.312	80.5	29.269	80.5	29.276	81.5	......	....	......	....	....	......	....	......	...	....	.....	....	....	.....
9 15	29.317	82.0	*29.290	77.7	29.286	83.5	......	......	.....	......	.....	....	....	.....	74.4	....	....	....	....	.....
9 23	29.327*	84.0	*29.285	75.5	29.262	84.7	......	......	....	......	......	......	....	....	74.0	......	.....	....	....	.....
9 43	29.320	84.0	*29.267	75.5	29.240	86.0	.....	......	....	...	......	....	......	......	75.5	......	....	....	....	.....
9 53	29.322	85.5	*29.268	75.5	29.284	87.0	......	.. ..	....	..	......	....	....	.....	75.7	......	.....	....	....	.....
10 25	29.326*	92.0	*29.259	80.5	29.284	92.0	.....		...	..	....	....	.....	....	81.5	......	.....	W. 1	Clear	133
0 25 P. M.	29.318	93.5	*29.269	85.7	29.262	94.5	88.0	74.5	99.0	94.7	129.0	107.0	95.0	88.0	86.7	...	...	Calm	Clear	.....
2 00	29.283	99.8	29.228	92.5	...		100.0	..	......	....	......	......	....	....	......	.	65.4	Calm	Clear	.....
3 00	29.260	....	29.201	93.9	29.228	101.0	101.9	72.0	....	..	......	......	......	......	......	71.0	......	Calm	Clear	.....
4 00	29.240	92.5	29.140	92.5	29.179	99.5	99.5	72.5	......	......	......	....	...	......	93.8	70.5	.....	Calm	Clear	......
5 00	29.227	....	29.161	91.0	29.168	98.1	98.1	74.5	......	....	......	......	......	.....	91.5	71.5	......	Calm	Clear	......
6 00	29.218	......	29.160	89.7	29.162	97.0	94.9	70.1	....	......	......	....	....	....	89.0	71.0	......	Calm	Clear	......

* NOTE.—The readings marked (*) are taken 3 feet above Mill creek water, near the observatory, to obtain the difference in level and the error which is incurred by reading off the barometer after transportation.

Observations for difference between the observatory, Lieutenant Mullan's camp, and the hospital.

Date.	Hour.	Place.	Barometer.	Readings.	Attached.	Detached.	Dry.	Wet.	Remarks.
1859.	h. m.				°	°	°	°	
June 21	6 00 P. M.	Observatory	Aneroid	29.218	....	....	....	....	
		Do	1973	160	89.7	....	....	....	
		Do	1975	162	97.0	....	84.9	70.1	
	6 40	Lieut. Mullan's camp	1973	153	84.8	82.5	....	....	
	10 00	Observatory	Aneroid	130	69.4	65.1	....	....	
		Do	1975	100	70.8	69.4	....	....	
22	1 10 A. M.	Lieut. Mullan's camp	Aneroid	175	67.0	....	....	....	
	6 00	Do	Aneroid	222	....	....	....	....	
		Do	1973	180	64.6	63.5	65.5	56.5	Water 54.3 deg.
		Do	1973	201	70.3	64.5	....	....	
	7 00	Do	1973	222	79.0	79.7	78.0	61.5	
	9 12	Observatory	1975	233	90.3	....	92.0	72.0	Water 56 deg.; W. SW.; clear.
	0 40 P. M.	Lieut. Mullan's camp	1973	235	96.2	....	....	....	
		Observatory	....	....	....	....	92.7	69.5	Water 63.5 deg.
	2 00	Do	1975	29.250	107.5	....	....	....	
	3 30	Lieut. Mullan's camp	1973	180	94.5	96.0	....	....	
		Observatory	1975	176	104	....	97.0	70.8	Ground 140 deg.
	4 30	Lieut. Mullan's camp	1973	158	96.0	98.0	....	....	Sudden wind, SW. 3.
	6 00	Do	1973	135	90.5	88.0	....	....	
		Observatory	....	....	....	....	88.0	72.5	Water 69 deg.; calm; clear.
	6 30	Lieut. Mullan's camp	1973	130	92.0	93.0	....	....	
		Observatory	1975	136	101.0	....	....	....	Calm; clear.
23	4 00 A. M.	Hospital	1973	29.087	63.2	64.2	....	....	
	6 00	Do	1973	118	75.8	....	....	....	
		Do	1975	122	76.2	76.0	78.7	67.0	
		Do	Kendall	....	....	....	86.4	79.6	

NOTE.—The hospital is a meteorological station for the United States army, and is provided with Kendall's dry and wet bulb thermometers, and a rain gauge. The thermometers being placed too near the wall, were effected by the morning sun, and have a large index error. Barometer 1275 was left at the hospital in care of Dr McParlin

The observations at Walla-Walla are continued with barometer 1275 from July, 1859, to March, 1860, and are given in the appendix, besides the results of the rain guage observations for eighteen months.

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Aneroid.	Attached.	Barometer.	Attached.	Detached	Wet.	Water.	Wind.	Clouds.	Remarks.
1859.	h. m.					°	°	°	°			
June 23,	6 00 A. M.	Walla-Walla hospital			29.118	75 8	76 0	67.0				Dry 78.7 deg.
	8 11	1st high point on road			29.145	93 4	90.8			W. 1.	Clear.	
	9 05	2d high point on road			29. 11	96.6	95 5			W. 1.	Clear.	
	9 40	Camp on Dry creek			29.215	92.5	90.3			W. 1.	Clear.	
	11 40	do do	29.178		29.179	96.0	98.6			W. 2.	Clear.	
	2 30 P. M.	do do	29.142		29 105	104.5	103.7	69 0	64.0		Clear.	Dry 98 deg ; ground 134 deg.
	3 40	do do	29 093		29.041	99 6	99.3			W. 3.	Clear.	
	4 10	do do	29 072		29 027	101.0	100 5			W 4-6.	Clear.	
	5 00	do do	29 042		29.001	99 6	98.8			W. 6		
	6 10	do do	29.035		29.002	93 8	91.2			W. 4.		
	7 30	do do	29 070		29.049	87.7	87.0			W. 4.	Stra. 0.7.	
June 24,	4 00 A. M.	do do	29.158		29.151	61 0	60.3					
	7 40	Divide			28.810	66.6	66.3			S. 3	Clear.	In a wolf's hole 53 deg.
	11 00	Camp on Touchet	28.985		28.984	75 8	73.5	61.5	58 0	S.SW. 4.	Clear.	Dry 73.5 deg.
	0 25 P. M.	do do	28.964		28 938	77.0	75.3	59.5	59 5	S 2.	Hazy.	Dry 75.3 deg.
	1 30	do do	28 938		28.922	81 5	76.6	56.5	59.5	S. 2.		Dry 76 6 deg.
	2 00	do do	28.915		28.917	82.0						Tent 6 feet above the crossing.
	3 00	do do	28.903		28.905	81.0	81.7					
	4 00	do do	28.863		28 864	75.3	76.0					Attached to aneroid 74.6 deg.
	5 00	do do	28.840		28 839	74.0	75 5					Attached to aneroid 73.5 deg.
	6 00	do do	28.828									Attached to aneroid 70.2 deg.
		Spur, 1½ miles W.SW			28.446	72.6	72 1			W. 5.		
	7 00	Camp on Touchet	28.832		28 838	68.5						Attached to aneroid 68.0 deg.
	10 15	do do	28.837		28.836	53.0				W. 2.		Attached to aneroid 53.3 deg.
June 25,	5 50 A. M.	do do	28 864		28 858	55.3	55 0			SW. 3.	Str. N. 0 8	
	11 50	do do	28 863		28.864	67.5	68.4			SW. 3.	Str. N. 0 8.	
	2 00 P. M.	do do	28.842		28 848	71 5	73.0			SW. 3.	Str N 0 8	
	5 15	do do	28.782		28.770	65.0	66 0			SW. 3.	Str N. 0 8.	
	6 00	do do						57.5	56.5	SW. 3.	Str. N. 0.8.	Dry 64.7 deg.
	7 40	do do	28.775		28.782	60 0	60.7			W. 2.		
	9 10	do do	28.770		28 776	54 0	54 3					
June 26,	3 25 A. M.	do do			28.770	45.5	46 0					
	6 00	Middle of a valley			28.651	56 3	51.0			SW. 1.	0.8.	
	7 20	Reed creek, grove of trees			28.493	59.0	57.5			SW. 2.	0.7.	
	8 45	Reed creek, 1st crossing			28.380	65.5	62.5	53.0	52.7	W.SW. 3.	0.1.	

	9 45	Reed creek, 3d crossing	......	......	28.190	69.0	65.5	58.0	55.0	......	......	Crawfishing.
	10 25	do do	......	......	28.118	68.0	64.5	......	......	......	......	Spring 2¼ feet below.
	11 10	Head of Reed creek	......	......	28.000	68 0	68.0	......	54 0	......	......	
	0 15 P. M.	do do	......	......	27 990	73.0	68.5	......	......	S. 3.	Clear.	
	1 00	do do	......	......	27.181	71.0	68.3	......	......	......	......	
	1 15	do do	......	......	27.972	76 0	72.0		......	......	......	
	1 30	Camp head of Reed creek	27.927	......	27.932	74.0	74.3	61.0	......	......	......	
	5 00	do do	27.905	......	27.896	74.0	73.7	......	......	......	......	
	5 40	do do		......	......	......	70 7	57.0	......	SW. 2.	0 5.	
	7 00	do do	27.878	......	27.868	67.7	67.7	......	......	......	......	
	7 40	do do	......	......	27.854	65.0	64.0	......	......	......	......	
	7 48	Hill, northward	27.572	65.4	......	......		......	......	S. 2.	0.8.	
	8 25	Camp, head of Reed creek	27.865	64.5	27.847	62.5	62.7	......		......	......	
	9 25	do do	27.855	......	27.835	55.5	56.2		53.2	......	......	
June 27,	3 30 A. M.	do do	27.880	......	27.866	56.0	56.5	47.7	53.0	S. 1.	N. 1.0.	
	5 25	Divide	27.527	57.7	27.493	56 7	55.8	......	......	S. 2.	N. 1.0.	1,645 feet above crossing.
	5 40	do	27.523	57.0	27.475	56.3	56.0	......	......	S. 3.	N. 1.0.	
	6 10	do	27.525	57.0	27.483	......	......	......	......	......	......	
		Divide, hollow	27.652	57.9	27.624	56.2	......	......	......	......	......	
	7 30	On the road	......	......	......	......	64.5	......	......	......	......	
	8 40	Tucañon, crossing	29 160	68.4	29.174	64.4	62.8	......	......	......	......	Raining.
	10 50	Tucañon, mouth	29.263	73.3	......	......	......	......	......	W.SW. 5	Cum. 0.1.	19 feet below cistern.
	11 20	do do	......	......	......	......	75 0	62.3	61.2	......	......	Snake river.
	1 00 P. M.	Under the Mulwagen	29 280	77.7	......	......	......	......	......	SW. 6.	Cum. 0.2.	Rattlesnakes plenty.
	1 35	Camp Fort Taylor	29.300	83.3	29.281	77.0	......	......	......	S. 6.	......	
	2 15	do do	29 318	86 7	29 322	83.9	83.4	67.5	......	......	......	
	4 00	do do	29.316	86 5	29 322	84.2	83.2	......	61.0	S.SW. 3–6	......	
	6 00	do do	29.364	78.6	29 316	78.4	77.5	......	......	S.SW. 3.	Clear.	
	7 05	do do	......		29.360	77.0	76.3	......	......	......	......	
		Top of Basalt wall	29.042	72 0	......	......		......	......	SW. 6.	......	319 feet above camp.
	11 20	Camp Fort Taylor	29.515	......	29 498	59.0	58.8	......	......	S. 6.	Clear.	
June 28,	6 15 A. M.	do do	29.643	63.5	29 650	63.5	61.7	......	......	......	......	
	7 10	do do	29.647	65.2	29 648	65.0	64.7	......		Calm.	Clear.	
	8 25	do do	29 666	72.2	29 655	71.2	70.7	......	61.0	SE. 1.	Clear.	
	9 37	do do	29.665	......	29 658	76.0	76 5	......		......	......	
	11 00	do do	29 660	......	29.660	82.3	82.0	......	55 8	......	......	Tucañon.
	11 30	do do	......	......	......	......	73.0	61.5	62.0	Calm.	Clear.	Snake river is now 4.5 feet below high-water mark; fell the first day 9 in.
	2 00 P. M.	do do	29.603	......	29.603	92.0	90.0	......	......	NE. 1.	Clear.	
	4 15	do do	29 580	......	29 574	90.5	89.2	......	......	E. 1.	Clear.	
	6 00	do do	29.565	......	29.550	88.0	86.5		......	Calm.	Clear.	
	6 30	do do	......	......	......	......	84.0	60.3	62.3	......	......	Snake river.
	7 40	do do	......	......	......	......	70.5	60.1	60 8	......	......	Temperature on shore.
	7 45	do do	29.570	......	29 520	78 0	78.0	......	......	......	......	
June 29,	6 00 A. M.	do do	29.503	......	29.510	66.0	66.3	......	......	E. 1.	Clear.	
	7 30	do do	......	......	......	......	......	59.5	62.3	S. 3.	Clear.	
	8 15	do do	29 564	84 5	......	......	80.2	......	......	S. 2.	Clear.	Shade behind a wagon.
	8 45	do do	29 580	83.0	29 566	86.8	86.8	......	......	......	......	
	10 00	do do	29 592	91.5	29.560	92.0	92.0	......	......	......	......	At 10h. 20m. started back to the divide.
	11 00	do do	29.590	91.0	......	......	......	......	......	......	......	
		Crossing of Tucañon	......		29 485	90.2	90.2	66.5	58.0	......	......	Tucañon.
	9 00 P. M.	Fort Taylor	29.561	97.2	......	......	......	......	......	......	......	
		Divide	......	......	27.913	90.8	88.4	68 3	......	W.SW. 3.	Clear.	1,735 feet above Snake river.
	4 50	Crossing of Tucañon	......	......	29.422	92.0	92.0	67.0	60.8	W. 1.	Clear.	Fall of Tucañon 40 feet to the mile.

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Aneroid.	Attached.	Barometer.	Attached.	Detached.	Wet.	Water of Snake.	Wind.	Clouds.	Remarks.
1859.	h. m.			°		°	°	°	°			
June 29,	6 10 P. M.	Fort Taylor	29.505	93.8	29.464	93.7	92.8	......	......	......	0.1.	
	9 40	do	29.497	79.0	29.468	78.5	78.5	......	......	W.SW. 1.	......	
June 30,	4 00 A. M.	do	29.477	65.0	......	......	62.0	56.5	60.0	SW 4.	......	Snake river fell 9 inches.
	8 00	do	29.503	72.2	......	......	......	......	......	S.SW. 4.	Nimb. 1.0.	
	9 30	do	29.515	72.3	29.508	72.5	73.7	......	......	SW. 4.	......	
	Noon.	do	29.510	87.5	29.500	89.0	90.0	......	......	S.SW. 6.	N. S. 0.6.	
	4 00 P. M.	do	29.512	84.0	......	......	......	......	......	SW 6.	......	
	7 00	do	29.538	78.3	......	......	......	......	......	W. 2.	N S. 0.5.	
	8 00	do	......	......	......	......	78.0	60.3	62.7	SW. 2.	N S 0.3.	Water of Tucañon 60°. Snake river fell 8 inches.
	9 15	do	29.542	70.5	......	......	......	......	......	SW. 2.	N S. 0.1.	
	11 00	do	29.560	64.0	......	......	62.5	......	......	S.SW. 1.	Clear.	
July 1,	4 15 A. M.	do	29.522	58.0	......	......	......	......	......	S 1.	Cum. 0.1.	
	5 00	do	29.520	64.0	29.519	62.0	63.4	54.0	61.5	SE. 1.	......	
	6 00	do	29.542	65.5	29.546	67.0	65.5	......	......	Calm.	Cum. 0.1.	
	7 00	do	29.537	72.5	29.550	73.0	72.5	......	......	......	......	
	8 00	do	29.538	76.0	29.554	76.2	76.0	......	......	NE. 1.	Clear.	
	9 30	do	29.513	81.5	29.508	82.0	81.5	......	......	S.SW. 3.	......	
	11 40	do	29.514	87.0	29.524	90.0	87.0	......	......	S.SW. 3.	Clear.	
	1 00 P. M.	do	29.460	......	29.440	93.5	92.0	......	......	......	......	
	2 00	do	29.470	......	29.433	93.0	92.0	......	......	......	......	
	3 00	do	29.460	......	29.460	93.7	91.0	......	......	......	......	
	3 55	do	29.450	......	29.460	92.9	91.0	......	......	......	......	Calligan.
	4 00	do	29.448	......	29.448	92.8	92.0	......	......	......	......	Kolecki.
	4 05	do	29.444	......	29.440	92.8	92.5	......	......	......	......	Wiessner.
	6 03	do	29.408	......	29.410	88.4	88.3		......	SW. 2.	Clear.	
	8 00	do	29.403	......	29.408	78.8	78.8	63.8	64.7	SW. 2.	Clear.	Snake river fell. 6 inches.
July 2	4 30 A. M.	do	29.418	......	29.456	53.5	54.0	......	......	Calm.	Clear.	
	5 25	do	29.439	......	29.464	61.7	58.0	52.7	64.0	......	......	
	7 00	do	29.477	......	29.482	73.6	74.0	......	......	SE. 1.	Clear.	
	8 00	do	29.465	......	29.491	75.5	75.3	......	......	SE. 1.	Clear.	
	10 40	do	29.405	......	29.496	84.0	81.0	......	......	Calm.	Clear.	
	Noon.	do	29.450	......	29.452	86.4	87.0	......	......	Calm.	Clear.	
	2 00 P. M.	do	29.416	......	29.468	90.0	90.0	......	......	......	......	
	3 30	do	29.384	......	29.400	90.5	90.8	......	......	S.SW. 2.	Clear.	
	5 50	do	29.343	......	29.380	86.0	88.9	......	......	S.SW. 2.	Clear.	Snake river fell 4 inches.

9 10	do	29.335		[illegible]	81.0	81.0			S. 3.	Clear.	Measured the width of Snake river by a triangle 600 feet base and the angles 35° and 127° at the base, to be nearly 900 feet. The current is very swift, about 9 feet per second. It takes 8 minutes to cross, and 1h. 0m. for a round trip.
July 3, 6 30 A. M.	do	29.485		29.466	63.5	63.0			SE. 3.	Clear.	
8 00	do	29.483		29.490	76.3	70.3			SE. 1.	Clear.	
9 30	do	29.460		29.400	74.0	73.5			S. 1.	Clear.	
11 20	do	29.460		29.456	80.5	81.0	69.0	65.0	S. 2.	Clear.	
1 30 P. M.	do	29.459		29.451	87.0	86.0			SW. 2.	Clear.	
3 10	do	29.438		29.446	89.6	88.9			S.SW.	Clear.	
5 30	Camp on bank	29.385	93.6								
6 00	Opposite Fort Taylor	29.403	93.5	29.367	91.5	93.5			SW. 1.	Clear.	
6 45	do. do	29.400		29.398	86.8	86.5					
7 20	do. do			29.383	84.8	84.7			W.SW. 1.	Clear.	
	1st terrace	29.057	84.0								
7 36	Camp			29.376	81.0	79.0					
	2d terrace	28.770									
7 45	Camp			29.378	78.5	77.5					
	Hill, signal	28.710	67.3								
8 00	Camp			29.383	77.0	76.0					
	Station 4	28.960									
	Station 5	29.010									
	Station 6	29.160									
9 10	Camp	29.385	70.5	29.373	71.0	70.5			E. 1.	Cum. 0.1.	
10 00	do			29.372	69.4	69.4			S.SW. 5.	Clear.	
Midnight.	do	29.440	70.5						NE. 1.	Stra. 0.1.	
July 4, 4 20 A. M.	do	29.558	59.0							Cir. 0.2.	
5 20	Snake river	29.620	61.8	29.610	64.9		53.5	65.0	SW. 2.	Cir. 0.3.	
7 00	1st terrace	29.110	71.0								
7 12	Hollow	29.170									
7 25	Basalt rock	29.005	70.5								
7 45	Divide 1	28.955									
8 10	Castle rock cañon	29.220									
8 23	Divide 2	29.020									
8 45	Meadow bottom	29.255		29.250	80.0	78.5			SW. 4.		
9 40	Divide	28.645	77.5								
12 00	Pelouse wall	28.940	85.0								Berry region.
1 00 P. M.	1st camp on Pelouse	29.120	91.0								
3 00	do. do	29.090	82.3	29.039	83.5	82.5	66.8	69.5		Cir. 0.3.	
4 00	do. do	29.038	81.5	29.022	82.0					Cir. str. 0.5	
5 30	do. do	28.996	79.8	28.991	82.0	80.0	63.5	69.6			
7 00	do. do	28.973	70.8	28.983	71.5	71.0	64.0	69.2			
9 00	do. do	28.968		28.950	64.0	63.0			Calm.	Clear.	
11 00	do. do	28.952		28.945	60.4	60.0			Calm.	Overcl'd.	
July 5, 4 30 A. M.	do. do	28.936		28.931	59.5	58.6				N. S. 1.0.	
5 00	do. do					61.5	54.5	61.0			
6 40	do. do	28.960		28.978	66.4	66.5			Calm.	N. S. 1.0.	Pelouse, 10 feet below high-water mark.
9 30	do. do	29.035	81.0	29.003	77.1	78.0	82.6	66.2	Calm.	N. S. 1.0.	Basalt rock to the right 28.79.
10 00	On the road	29.020	82.0								
	Road leading left	28.943									
	Road at bluff to right	29.006									Beautiful spring 54°.2 in the Pelouse.
12 00	1st crossing of Pelouse	29.042	92.0					67.5			
1 00 P. M.	do. do	29.045		28.946	85.9	87.7	66.0				
3 30	Road, highest point	28.910									Aneroid got wet.
4 00	2d camp on Pelouse	28.958	88.0				68.0	69.8			
7 30	do. do	28.925		28.842	83.0	82.5			NE. 1.	Clear.	

Meteorological observations—Continued

MILITARY ROAD.

Date.	Station or camp.	Aneroid.	Attached.	Barometer.	Attached.	Detached.	Wet.	Water.	Wind.	Clouds.	Remarks.
1859. h. m.			°		°	°	°	°			
July 6, 2 30 A. M.	2d camp on Pelouse........	28.940	......	28.858	60.2	60.4	......	......	......	......	
4 15	..... do..... do	28.948	......	28.874	57.8	59.0	......	......	Calm.	C S. 0.1.	
6 00	Pelouse dead water.........	28.990	69.2	28.924	68.2	...	......	......	......	......	
6 40	.. do... 1 mile above......	28.980	75.0	28.918	75.5	75.0	66.0	66.6	NE. 1.	C. S. 0.7.	
10 15	3d camp on Pelouse........	28.958	......	28.863	94.0	94.2	......	......	E.SE. 3.	N. S. 0.8.	12 feet above water.
11 30	..... do...... do	28.977	......	28.884	87.5	86.5	......	......	W. 3.	......	Towards west thunder.
Noon.	...... do...... do	28.995	81.5	......	......	......	......	......	W. 5.	......	Raining a few drops, 0.01 inch.
0 08 P. M.	...... do...... do	28.980	76.0	......	......	......	......	......	......	......	
0 19	...... do..... do	28.947	75.0	......	......	......	......	......	E. 2.	......	
0 30	..... do..... do	28.885	87.0	......	......	......	......	......	......	......	Storm over, sun out.
2 40	.... do..... do	28.965	87.0	......	......	......	......	......	SE. 4.	......	Rain 0.02 inches.
4 50	..... do...... do	28.9 5	81.5	......	......	......	......	......	S.SE 3.	N. S. 0.6.	
6 15	..... do..... do	28.875	80.0	......	......	......	......	......	Calm.	N. S. 0.7.	
7 30	.... do...... do	28.865	73.6	......	......	......	......	......	Calm.	N. S. 0.6.	During the night thunder and lightning.
July 7, 5 00 A. M.	...... do...... do	28.940	......	28.883	61.0	60.0	......	......	Calm.	Cum. 0.1.	Rain 0.07 inches.
7 00	...... do..... do	28.956	......	28.892	67.0	66.5	60.0	67.0	S. 2.	Cum. 0.1.	Shade near water 65°.
9 15	.... do..... do	28.995	......	28.935	77.0	79.0	......	......	S. 2.	Cum. 0.1.	
11 30	..... do..... do	28.982	......	28.907	85.5	84.5	......	......	S.SW. 2.	Cum. 0.3.	
1 15 P. M.	..... do... . do	28.947	......	28.893	85.4	84.6	......	......	SW. 3.	Cum. 0.1.	
2 00	.....do......do	......	......	......	......	88.5	68.0	71.5	......	......	Shade near water.
3 00	.... do .... do	28.900	......	28.881	89.0	88.4	......	......	S.SW 2.	Clear.	
4 45	......do..... do	28.864	......	28.844	87.2	87.8	......	......	W SW. 2.	Clear.	
6 00	.... do..... do	28.85[illegible]	......	28.843	85.9	81.5	......	......	W SW. 2.	Clear.	
7 00	.... do......do	28.878		28.848	74.2	73.8	......	......	SW. 3.	Clear.	Fog. Dry.
	Castle bluff	28.704	73.5	......	......		......	......	......	......	South from camp.
9 45	3d camp on Pelouse ...	28.934	......	28.908	64.0	61.0	......	......	S. 3.	Clear.	
July 8, 4 00 A. M.	......do......do	28.980	......	28.940	46.0	46.0	41.6	66.0	W. 1.	Clear.	Open air 44°. No dew.
7 00	.... do..... do	29.028	......	29.032	60.0	61.0	......	......	W SW. 2-3.	Clear.	
9 00	......do......do	29.080	......	29.063	69.0	68.0	......	......	W.SW. 3.	Clear.	
11 30	..... do......do	29.075	......	29.060	78.0	78.0	......	......	W SW. 3.	Clear.	
3 45 P. M.	..... do......do	28.963	......	28.982	80.5	80.4	......	......	Calm.	Clear.	
	Ridge to the north...........	28.450	......	......	......	......	......	......	......	......	
5 45	3d camp on Pelouse........	......	......	28.898	80.5	79.3	......	......	......	......	
7 45	......do......do	28.945	......	28.874	69.0	61.0	55.0	68.6	Calm.	Clear.	Shade near water 58°.5.
July 9, 4 00 A. M.	......do......do	[illegible]	......	[illegible]	40.0	43.0	......	63.0	......	N. S. 0.1.	Min. 39°.

		Road, highest point	[illegible]									
	6 00	Spring	28.785				55.0	47.0	53.0			
		3d crossing of Pelouse	28 800				63.0		63.6			Commencement of pine.
	7 00	Wooded island, Pelouse	28.875	70.5	28.798	67.8						4th crossing.
	9 30	Pine tree station	28.890	70.0	28.733	75.0						6th above the Pelouse.
	11 00	4th camp, Pelouse	28.781									The 5th crossing.
	12 00	2d terrace east of camp	28.540									
	1 00 P. M.	Hill north of camp	28.280	86.5								Meet the first Indian.
	2 00	4th camp on Pelouse	28.645		28 602	89 5	80.8			E. 1.	Clear.	20 feet above water.
	3 00	do do	28.580	90.3	28.605	90.6				NE	Clear.	
	6 00	do do	28.570		28.560	87.8	88.5					
	7 30	do do	28.540		28.520	78.0	74.6	62 0	73.0			
July 10,	5 00 A. M.	do do	28.644	61.4						S. 5.	Overcl'd.	
	7 15	do do	28.677	61.3					68.0		0.5.	Pine tree 10.5 feet in circumferance.
	10 00	do do	28.745	76.0						S. 4.	Clear.	
	1 30 P. M.	do do	28.735	82.7						S.SW. 4.	Clear.	
	3–4	do do						67.0	75.0			Flint stone, spring 59° .5.
	6 00	do do	28.700	75.5						Calm.	Clear.	
	11 20	do do	28 683	51.2						Calm.	Clear.	Northern light.
July 11,	4 00 A. M.	do do	28.696	44.7						Calm.	Stra. 0.2.	
	4 45	At the surface of Pelouse	28.720		28.734	46.0	44.3	40.0	64 0	S. 1.	Cir. 0.2.	
	5 45	On the road, high point	28 395									
	7 20	On the road, pond	28.510									
		Spring	28.486						49 8			
		Red pond	28.346				62.5	50.5	61.0			
		Divide	28.370									About 30 feet higher than Red pond.
	10 00	Oreteus	28.430						69.5			Called also Inquastep.
	12 00	Camp, Oreteus	28.417							W. 3.		
	4 00 P. M.	do do	28.322		28.266	88.5	88.0					
	5 45	do do	28.290		28.235	85.0	84.0			N. 2.	Cir. st. 0 6.	
	7 00	Rock Housta	28.125	74.5								North from camp.
		Camp, Oreteus			28.296	74.0	73.0			W. 1.	Cir. st. 0.7.	During the night thunder and lightning on NW. horizon.
July 12,	3 00 A. M.	do do	28.337		28.277	53.5	53.5			S.SW. 3.	Cum. 0.5.	
	4 00	Spring	28.305				49.0	43.0	52.0			
	7 00	Creek, running into a ditch	28.205		28.157	57.0	56.0		50.0			Spring of creek 47.6, 120 feet higher.
		Lake	27.957									Spring near ditch 52°.
	11 00	Divide	27.870									
	1 30 P. M.	Tcho-tcho-u-seepe	28.024		27.992	73.7	71.0		49.5			Camp with a very large spring, lake 200 feet lower.
	4 15	do	28.020		27.972	70.0	69 5			SW. 4.	Clear.	
	6 15	do	28.000		27.950	67.0	66.3			SW. 4.	Clear.	
	9 00	do	28.017		27.997	52 8	53.0			Calm.	Clear.	
July 13,	3 30 A. M.	do	28 060		28 010	45.0	40.3	33 2	49 0	Calm.	Clear.	
	6 40	Aspen and pine	27.877		27.805	54.7	50.6			S. 3.	Clear.	
	7 45	Large pine	27.965									Pond 27.870.
	2 40 P. M.	Sil-sie-pow-vet-sin	28.050		28.006	75.8	73.8			Calm.	Clear.	55 feet above crossing.
	5 00	do	28.040		28.002	71.8	70.0			Calm.	Clear.	Lake, A. 28.075; water 71°.
	6 00	do	28.017		27.982	71.0	70.0			Calm.	Clear.	Hill, SE., 27.740.
	10 30	do	27.970		27.948	48.8	49.5			Calm.	Clear.	
July 14,	3 45 A. M.	do	27.930		27.894	44.8	41.0	38.5	58.0	Calm.	Hazy.	Some dew.
	7 30	Near a lake	27.723	60 2	27.675	60.5						Spring 50°.
	9 00	Divide	27.555									Hill near 27.590.
	11 00	Pine tree	27.750									Circumference 16.5 feet, shade 65 feet.
	Noon.	Spring					75.5		52.0			Two rattlesnakes between the feet.

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Aneroid.	Attached.	Barometer.	Attached.	Detached.	Wet.	Water.	Wind.	Clouds.	Remarks.
1859.	A. m.			°		°	°	°	°			
July 14,	3 00 P. M.	Lahtoo	27.800		27.740	77.8	76.5					Camass prairie creek.
	4 30	do	27.777		27.701	78.3	79.2			S. 1.	Cir. 0.1.	Hill around 140 feet higher.
	7 15	do	27.742		27.676	62.3	61.0			Calm.	Cir. 0.1.	Camp 12 feet above creek.
	10 20	do	27.700		27.640	45.0	46.3			Calm.	Clear.	
July 15,	4 00 A. M.	do	27.703		27.647	43.5	43.0			Calm.	Clear.	Min. 41.5.
	5 30	Crossing	27.735									
	5 50	High point	27.425									
	6 20	Springs	27.582		27.546	68.5	60.8	53.0	55.4	S. 3.	Cir. 0.1.	
	7 40	Hill to the right of divide	27.137	66.5	27.056	68.3				SW. 4.		To 8h. 45m.
	10 00	Divide	27.410									
	10 42	Valley	27.630									
	Noon.	Camp, Lo-chuls	27.545									
	0 40 P. M.	Lo-chuls	27.520		27.468	81.0	79 5			SW. 4.	Cir. 0.2.	Long valley with ponds.
	4 10	do	27.515		27.464	73.8	74.2	54.5	68.0	W.SW. 4.	Nimb. 0.9.	
	6 00	do	27.515		27.448	66.0	65.5			W.SW. 2.	Nimb. 0.8.	
	8 20	do	27.475		27.448	52 0	50.0			W. 1.	Nimb. 0.5.	
	10 15	do	27.445		27.430	46.5	46.5			Calm.	Nimb. 0.6.	
July 16,	4 00 A. M.	do	27.445		27.419	56.0	55.8			Calm.	N S. 1.0.	
	6 30	Divide	27.320									Rain about 0.04 inch.
	7 15	Lowest point between	27.520									
	8 00	In-chats-chan	27.370									Fine timber and berries.
	9 00	do	27.380		27.326	62.3	61.8			S. 2.	Nimb 0.7.	
	10 00	do	27.380		27.332	67.0	64.8	59.0	55 0	S. 2.	Nimb. 0.7.	At noon rain 0.02.
	4 00 P. M.	do	27.377		27.332	70.0	68.5				Nimb. 0.8.	Temperature of the water in the pond.
	7 10	do	27.381		27.368	62.0	60.8			S. 1.	Cum. 0.1.	
	10 20	do	27.383		27.376	44.0	45 0			Calm.	Clear.	
July 17,	4 20 A. M.	do	27.395		27.333	35.0	36.0			Calm.	Clear.	Min. 31.3.
	5 30	do	27.397		27.352	35 8	36.0			E 1.	Clear.	Some dew
	7 30	do	27.445		27.373	63.5	63.3		53.8	E. 1.	Clear.	
	9 00	do	27.486		27.456	72.6	72.0			E. 1.	Clear.	
	11 40	do	27.503		27.444	81.8	81.8			E. 1.	Clear.	
	2 00 P. M.	do	27.495		27.436	83.7	82.7			SW. 3.	Clear.	
	4 30	do	27.459		27.412	85.0	82.8	61.0	69.0	Calm.	Clear.	
	7 00	do	27.407		27.384	65.5	67.5			Calm.	Clear.	
July 18,	6 15 A. M.	do	27.385		27.344	43.0	44.0			Calm.	Clear.	

	5 30	do	27.440	......	27.390	41.5	41.5	......	......	E. 1.	Clear.	
	6 30	do	27.444	......	27.383	59.0	61.3	......	......	E. 1.	Clear.	
	7 35	do	27.477	......	27.438	70.5	70.8	......	51.0	E. 1.	Clear.	
	9 30	do	27.517	......	27.473	89.0	82.2	......	......	E. 1.	Clear.	
	0 05 P. M.	do	27.520	......	27.489	91.5	90.5	......	......	SE. 1.	Clear.	
	2 00	do	27.500	......	27.476	92.2	91.6	......	......	NE. 1.	Clear.	
	3 00	do	27.520	......	27.458	93.2	92.0	......	......	E. 1.	Clear.	
	4 00	do	27.501	......	27.454	94.0	93.0	......	......	Calm.	Clear.	
	5 00	do	27.480	......	27.446	92.8	90.8	......	......	Calm.	Clear.	
	6 00	do	27.455	......	27.404	80.8	82.5	......	......	Calm.	Clear.	
	7 00	do	27.439	......	27.383	71.5	68.0	......	......	Calm.	Clear.	
	10 40	do	27.382	......	27.330	53.0	53.8	......	......	Calm.	Cir. 0.4.	
July 19,	5 00 A. M.	do	27.340	......	27.308	44.8	45.0	......	......	Calm.	Cir. 0.3.	
	7 00	do	27.330	......	27.317	70.0	71.0	......	......	E. 1.	Cir. 0.3.	
	9 00	do	27.387	......	27.337	82.3	82.0	61.0	62.5	Calm.	Cir. str. 0.3	
	11 40	do	27.430	......	27.386	92.3	91.0	......	......	S. 1.	Cir. str. 0.7.	Max. 96°.
	0 30 P. M.	do	27.459	......	27.394	86.8	81.5	......	......	SW. 1.	Cir. str. 0.9	
	2 00	do	27.480	......	27.401	80.0	60.5	......	......	SW. 1.	Cir. str. 1.0.	
	6 00	do	27.400	......	27.356	71.7	71.5	......	......	Calm.	Cir. str. 0.9	
	7 15	do	27.397	......	27.356	67.5	66.5	60.5	......	Calm.	Cir. str. 0.9	
July 20,	6 00 A. M.	do	27.395	......	27.357	55.0	56.0	50.0	......	E 1.	Clear.	
	7 30	do	27.456	......	27.424	74.0	72.0	62.0	......	E. 1.	Clear.	A. at a hill to the left of road 27.158.
	9 00	do	......	......	27.446	85.0	84.0	......	......	Calm.	Clear.	H. at bridge on St. Joseph 28.035.
	10 00	do	......	......	27.454	93.0	92.0	......	......	Calm.	Clear.	Water of lake 73°.
	11 00	do	......	......	27.472	94.2	92.8	......	......	Calm.	Clear.	
	Noon.	do	......	......	27.468	98.5	95.5	......	......	Calm.	Clear.	
	1 00 P. M	do	......	......	27.464	96.5	95.0	......	......	Calm.	Clear.	
	2 00	do	......	......	27.436	97.0	95.0	......	......	Calm.	Clear.	Bridge on St. Joseph 27.935.
	3 00	do	......	......	27.436	96.0	95.5	......	......	Calm.	Clear.	Divide 27.907.
	4 00	do	......	......	27.418	96.0	94.0	......	......	Calm.	Clear.	
	5 00	do	......	......	27.378	94.8	93.0	......	......	Calm.	Clear.	Pine 17 feet in circumference, 170 high.
	6 30	do	27.392	......	27.361	82.7	80.0	......	......	Calm.	Clear.	
	10 00	do	27.340	......	27.317	56.3	56.5	......	......	Calm.	Clear.	
July 21,	5 45 A. M.	do	27.319	......	27.283	55.0	56.0	......	......	Calm.	C. S. 0.2.	
	7 15	do	27.348	......	27.329	72.5	75.2	......	......	Calm.	C. S. 0.4.	
	8 00	do	27.377	......	27.362	77.0	76.7	62.0	......	Calm.	C. S. 0.7.	
	9 07	do	......	......	27.372	81.5	80.0	......	......	Calm.	......	
	11 07	do	......	......	27.402	93.8	94.0	66.0	77.0	Calm.	Cir. st. 0.8.	Aneroid carried to St. Joseph's river bridge :
	1 07 P. M.	do	......	......	27.384	94.3	93.5	......	......	Calm.	Cir. st 0.8.	11 a. m 27 927
	3 07	do	......	......	27.372	91.0	89.5	......	......	Calm.	Cir. st. 0.8.	5 p. m 27.885
	5 07	do	......	......	27.367	84.0	82.5	......	......	Calm.	......	Divide 27.045
	7 07	do	......	......	27.324	71.0	69.5	......	......	Calm.	......	Divide 27.180
	8 06	do	27.344	......	27.298	69.5	68.3	......	......	Calm.	......	
	9 00	do	27.312	......	27.298	67.5	67.0	......	......	Calm.	Stra. 1.0.	At night overclouded ; few drops of rain.
July 22,	6 30	do	27.297	......	27.285	68.0	71.5	......	......	Calm.	Cum. 0.3.	
	9 00	do	27.345	......	27.343	89.5	88.7	......	......	......	......	
	11 00	do	27.361	......	27.360	90.5	88.5	......	......	SW. 1.	Cum. 0.1.	
	1 00 P. M.	do	27.350	......	27.358	94.0	93.5	......	......	W. SW. 2.	Cum. 0.1.	
	3 00	do	27.317	......	27.319	93.5	93.3	......	......	SW. 1.	Cum. 0.2.	
	5 30	do	27.305	......	27.279	84.0	84.5	......	......	Calm.	Cum. 0.1.	
	8 00	do	27.272	......	27.242	64.5	64.5	......	......	Calm.	Cum. 0.1.	
	10 00	do	27.250	......	27.235	58.0	57.6	......	......	Calm.	Stra. 0.1.	
July 23,	9 30 A. M.	do	27.250	......	27.242	52.0	52.0	......	......	Calm.	Clear.	

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Aneroid.	Attached.	Barometer.	Attached.	Detached.	Wet.	Water.	Wind.	Clouds.	Remarks.
1859. h. m.					°	°	°	°			
July 23, 4 00 A. M.	In-chats-chan	27.970		27.940	48.5	49.0			Calm.	Clear.	Min. 44.2 degrees.
Divide	Divide	27.093									Bridge, 27.924
0 40 P. M.	Camp on St. Joseph's	21.857		27.802	83.5	83.0			Calm.	Cum. 0.1.	8 feet above water.
6 00	do	27.830		27.780	83.7	84.3			Calm.	Cum. 0.1.	
7 00	do	27.820		27.748	74.5	70.5	67.0	63.5	Calm.	Clear.	
9 50	do	27.785		27.736	61.0	60.5			Calm.	Clear.	2 shooting stars.
July 24, 6 00 A. M.	do	27.832		27.769	54.5	55.5			Calm.	Clear.	Dew.
7 00	do	27.860		27.802	63.0	63.5			Calm.	Clear.	
9 15	do	27.917		27.862	74.7	75.5			NE. 1.	Cir. 0.6.	
10 40	do	27.915		27.857	74.0	74.0					
Noon.	do	27.912		27.855	73.0	74.0			NE. 2.	Stra. 0.7.	
1 00 P. M.	do	27.885		27.850	77.0	75.0			NE. 1.	Stra. 0.7.	
3 00	do	27.885		27.841	85.0	85.5			Calm.	Stra. 0.6.	
6 00	Upper camp	27.856									7 feet above water.
9 00	Joseph's river upper camp	27.846		27.786	65.5	65.8					
July 25, 6 20 A. M.	do	27.920		27.856	58.5	58.5	56.3	63.5	E. 2.	Clear.	Dew.
9 15	do	27.945		27.863	71.3	71.5			E. 2.	Clear.	
11 00	do	27.940		27.887	79.5	80.0			E. 1.	Cum. 0.1.	
Noon.	do	27.940		27.886	85.0	85.0			E. 1.	Cum. 0.2.	
4 40 P. M.	do	27.918		27.875	90.0	89.5			Calm.	Cum. 0.2.	Pine, 18 feet circumference.
8 00	do	27.885		27.840	67.5	67.5					
July 26, 6 00 A. M.	do	27.942		27,878	56.5	56.5	53.5		Calm.	Cum. 0.1.	Dew.
7 00	do	27.976		27.922	62.0	62.5	59.0	65 0	E. 1.	Cum. 0.1.	
11 00	do	27.962		27.935	83.5	83.5			SE.	Cum. 0.1.	
1 00 P. M.	do	27.955		27.938	90.8	91.0	70.0	71.0	SE. 1.	Cum. 0.1.	
2 00	do	27.958		27.936	93.0	95.0			SE. 1.	Cum. 0.1.	
7 00	do	27.930		27.878	76.0	75.5			S. 1.	N Str. 0.8.	
9 20	do	27.924		27.874	70.0	69.0			Calm.	Smoky.	During night thunder and lightning, but no rain.
July 27, 6 45	do	27.946		27.910	65.5	65.5			E 2.	Clear.	
9 45	do	27.943		27.908	76.5	77 0					
10 45	do	27.938		27.908	89.0	89 3	71.0	69.5			
1 05 P. M.	do	27.895		27.900	92.5	92 7			Calm.	Cum. 0.1.	
3 [illegible]	do	27 875		27.850	97.5	96.0			W. 2.	Cum. 0.2.	Between 5 and 8 thunder, wind changed suddenly to E. 3, S. 5, W. 2, and N. 2.
5 [illegible]	do	27.810		27.776	89.9	91.2			W. 1.	Overcl'd.	
8 [illegible]	do	27.[illegible]				70.0				Overcl'd.	

July 28,	8 00 A. M.	......do	27.983	......	27.976	71.0	73.0	......	......	E. 2.	Cum. 0.1.	Rain, 0.05.
	10 00	......do	27.983	......	27.888	76.3	76.0	......	......	N. 2.	Cum. 0.9.	After midnight, clearing up, counted 25 shooting stars, and watched our oxen and horses.
	0 30 P. M.	......do	27.895	......	27.866	79.3	79.3	......	......	S. 2.	Cum. 0.1.	
	2 30	......do	27.890	......	27.858	82.6	82.3	......	......	S. 2.	Clear.	
	6 30	......do	27.855	......	27.807	72.6	71.8	......	......	Calm.	Cir. 0.7.	
	11 30	......do	27.882	......	....	58.5	59.5	......	......	W. 1.	Clear.	
July 29,	6 00 A. M.	......do	27.940	......	27.916	56.0	55.8	......	......	Calm.	Stra. 0.1.	
	10 20	......do	....	......	27.954	77.8	78.0	63.0	66.0	Calm.	Cir. 0.2.	Near the river, 74 degrees.
	2 15 P. M.	......do	....	......	27.934	85.0	85.0	......	......	Calm.	Cir. 0.1.	
	6 00	......do	27.902	......	27.849	78.0	78.5	....	......	Calm.	Cir. 0.1.	
	9 00	......do	27.870	......	27.892	58.0	58.3	......	......	Calm.	Clear.	
July 30,	5 00 A. M.	......do	27.910	......	27.862	46.5	47.0	......	......	Calm.	Clear.	Outside, 46 degrees. Dew.
	6 00	......do	27.922	......	27.864	55.5	55.5	51.5	......	....	Fog.	Outside, 53 degrees.
	8 00	......do	27.937	......	27.890	67.0	67.0	......	......	Calm.	Clear.	
	9 00	......do	27.940	......	27.900	72.5	72.5	......	......	E. 1.	Clear.	
	1 10 P. M.	......do	....	......	27.882	87.0	82.5	72.7	68.5	SW. 1.	Clear.	Spring at the old mission, 53 degrees.
	3 00	......do	....	......	27.838	90.2	......	......	......	W.NW. 1.	Clear.	Aneroid carried by Messrs. Engel and Sohon to Pyramid Peak of the Coeur d'Alene mountains.
	5 00	......do	....	......	27.806	88.7	......	......	......	W.NW. 1.	Clear.	
	7 00	......do	....	......	27.763	71.5	......	......	......	....	....	
	10 20	......do	....	......	27.784	64.0	......	......	......	Calm.	Overcl'd.	
July 31,	7 00 A. M.	......do	....	......	27.795	66.2	......	......	......	Calm.	Fog.	
	8 30	......do	....	......	27.798	69.0	....	....	......	Calm.	Fog.	
	10 00	......do	....	......	27.784	67.5	......	......	......	W. 2.	Fog.	
	Noon.	......do	....	......	27.786	76.7	......	......	......	Calm.	Fog.	
	2 00 P. M.	......do	....	......	27.760	77.0	......	......	......	Calm.	Fog.	
	4 00	......do	....	......	27.701	79.3	......	......	......	Calm.	Fog.	
	10 00	Bridge	....	......	27.662	75.0	......	......	......	S.SE.	....	
Aug. 1,	4 15 A. M.	Bridge	....	......	27.804	62.0	63.0	59.2	66.0	Calm.	....	Thunder towards south; few drops of rain.
	7 00	Coeur d'Alene lake......	....	......	....	......	63.0	....	67.0	....	....	Rain, 0.03.
	5 20 P. M.	Coeur d'Alene camp......	....	......	27.722	75.0	75.0	66.5	67.0	....	....	6 feet above water.
	7 20	......do	....	......	27.712	61.5	....	......	......	Calm.	Cum. 0.4.	
	Midnight.	......do	....	......	27.684	48.7	......	....	......	Calm.	Clear.	Musquitoes.
Aug. 2,	5 30 A. M.	......do	....	......	27.738	52.4	......	50.5	64.0	....	....	Dew and fog.
	6 30	......do	....	......	27.740	59.8	....	......	......	....	....	
	7 00 P. M.	Coeur d'Alene mission......	....	......	27.567	71.0	......	......	......	....	....	Camp 18 feet above slack water.

METEOROLOGICAL OBSERVATIONS.

CŒUR D'ALÊNE MISSION.

Date.		Aneroid.	Barometer.	Attached.	Detached, or dry.	Wet.	Black.	Naked.	OPEN AIR.				River.	Spring.	Rain.	Wind.	Clouds.	Remarks.
									4 ft. above.	1 ft. above.	½ in. above.	Ground.						
1859.	A. m.			°	°	°	°	°		°	°	°	°	°				
Aug. 3,	7 12 A. M.		27.543	67.0	64.5	57.0							52.5			Calm.	Clear.	18 feet above water; few form a creek.
	11 00													46.2				
	Noon.		27 512	96.0	93.0							115 0				S. 1.		Near church.
	1 40 P. M.		27.502	90.0												S. 6.		
	5 30		27.432	89.7													Nimb. 1.0.	Thunderstorm.
	7 30		27.403	72.0													Nimb. 1.0.	Wind moved around by NW. SE.
Aug. 4,	7 00 A. M.		27.640	58.5													Nimb. 0.8.	
	10 00		27.678	63.7													Nimb. 0.8.	
	0 30 P. M.		27.724	73.5													Nimb. 0.4.	
	2 30		27.768	76.3												NE. 2.	Clear.	
	4 00		27.747	78 5												Calm.	Cirrus 0.1.	
	7 00		27.748	64 0			60.0	60.0		58.6	59.2							Naked; is 4 feet above ground.
	9 09		27.742	56.0												Calm.	Clear.	
	Midnight.		27.698	48.5												SW. 1.	Clear.	
Aug. 5,	9 00 A. M.		27.532	63.7												S.	Fog.	
	11 30		27.540	71.5	69.0	57.6	73.0	71.0		69.0	70.0	73.0				SE. 1.	Fog.	
	2 00 P. M.		27.542	66.8	67.0	55.5	69 0	67.5		67.3	69.0	69.5				NE. 3.	Rainy.	Sudden storm.
	4 00		27.604	73.0	70.0	58.5	73.0	72.0		71.0	71.5	74.0				Calm.	Str.	
	6 00		27.610	69.0	68 6	57.5	70.0	69.3		68.0	69.0	68.0				S. 2.	Cirrus 0.2.	
	8 00		27.602	59.0	66.0	55.0	66.5	66 5		65.5	66.2	65.5				S. 1.	Cirrus 0 2	
	10 30		27.647	55.5												Variable.	Overcloud.	
Aug. 6,	1 00 A. M.		27.682	54.5														
	7 00		27.684	49.5	48.9	47.0	46.0	46.0		47.0	47 0	49.0			0.39	SW. 2.	Nimb 1.0.	Rainy.
	9 00		27.816	50.5	50 0	48.0	50.2	50.2		52.0	50.8	52.0				SW. 2.	Nimb. 1.0.	
	11 00		27.822	52 7	52.5	49.5	49.0	49.0		50.5	49.0	52.0			0.21	SW. 2.	Nimb 1.0.	Rainy.
	1 00 P. M.		27.842	55.0	51.0	48.0	54.0	53.0		53.0	51.2	58.0				SW. 2.	Nimb. 1 0.	Rain and hail.
	3 00		27.852	52.2	51.5	49.6	49.0	49.0		50.0	50.0	51.2			0 23	SW. 2.	Nimb. 1.0.	Rain and hail,
	5 00		27.847	53.0	52.5	50.7	51.0	51.0		52.0	51.0	54.8				SW. 3.	Nimb. 1.0.	
	7 00		27.850	51.0	51.5	50.0	49.5	49.5		51.0	51.0	51.0			0.04	SW. 1.	Nimb 1.0.	
	11 00		27.842	50.0	52.0											Calm.	Nimb. 1.0.	
Aug. 7,	7 00 A. M.		27 874	49.5	50.0	49.0	50.5	49.3		50.0	50.0	51.5						
	9 20		27.868	56.0	53.8	50.5	60.2	57.5		58.0	57.5	64.0				SW. 2.	Cirrus 0.7.	
	11 00		27.852	60.5	59.0	52.0	61.8	63.3		60.0	60.5	65.0					Cirrus 0.7.	
	1 00 P. M.		27.878	63.0	62.0	50.5	65.5	64.0		64.0	64.0	65.0				W.SW. 2.	Nim. 0.6.	
	3 00		27.884	66.0	64.8	54.5	72.0	69.5		69.0	68.3	70.0						

	5 00	.....	27.800	66.8	66.5	56.3	69.3	66.4	.....	68.0	67.0	67.0	.....	.....	.....	Calm.	Cum. 0.5.	
	7 00	.....	27.760	64.0	62.0	57.0	63.0	63.8	.....	62.0	60.0	57.0	.....	.....	.....	Calm.	Cum. 0.3.	
	9 00	.....	27.755	54.5	56.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
	11 00	.....	27.718	51.0	53.0	.....	.....	48.5	.....	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
Aug. 8,	5 00 A. M.	.....	27.692	48.0	49.0	.....	.....	45.5	.....	.....	.....	.....	.....	.....	.....	W. 1.	Clear.	Fog or smoke around the horizon very dense.
	7 00	.....	27.696	49.8	47.2	46.8	47.5	46.5	.....	47.0	46.5	49.0	.....	.....	.....	W. 1.	Clear.	
	9 10	.....	27.740	72.5	60.2	52.2	70.6	64.2	.....	60.5	59.0	55.0	.....	.....	.....	S. 1.	Clear.	
	11 03	.....	27.668	71.0	64.5	53.4	71.0	71.0	.....	70.5	70.0	78.2	.....	.....	.....	SW. 2.	Clear.	
	1 00 P. M.	.....	27.690	73.4	68.8	58.0	81.5	76.0	.....	75.5	76.0	95.0	.....	.....	.....	S.SW. 4.	Cirrus 0.1.	
	3 00	.....	27.684	73.5	72.5	59.2	82.4	77.4	.....	79.0	78.5	91.0	.....	.....	.....	S.SW. 4.	Cum. 0.1.	
	5 00	.....	27.672	72.4	71.8	55.5	75.0	74.0	.....	74.0	72.5	70.5	.....	.....	.....	E. 3.	Clear.	
	7 00	.....	27.674	67.0	65.0	54.8	64.0	64.0	.....	64.0	62.3	61.5	.....	.....	.....	SW. 1.	Clear.	
	9 15	.....	27.672	56.5	56.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
	11 00	.....	27.674	52.0	53.0	.....	49.0	49.0	.....	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
Aug. 9,	5 00 A. M.	.....	27.712	43.0	44.0	42.5	40.8	40.5	.....	40.8	47.2	47.0	.....	.....	.....	Calm.	Clear.	
	7 00	.....	27.716	46.2	49.0	47.0	47.0	46.5	.....	45.5	46.0	.....	.....	.....	.....	Calm.	Clear.	
	9 00	.....	27.792	67.5	58.0	53.5	60.8	60.0	.....	59.8	60.0	53.0	.....	.....	.....	Calm.	Clear.	
	11 05	.....	27.792	75.5	69.8	56.0	81.0	75.5	.....	74.0	76.0	81.0	.....	.....	.....	Calm.	Clear.	
	1 00 P. M.	.....	27.744	79.0	73.2	56.0	87.0	82.4	.....	78.2	80.0	93.0	.....	.....	.....	E. 2.	Clear.	
	3 00	.....	27.752	78.0	76.5	56.5	88.0	83.0	.....	82.0	85.0	95.0	.....	.....	.....	E. 2.	Clear.	
	5 00	.....	27.728	75.0	78.0	61.5	80.0	78.5	.....	76.5	78.0	77.5	.....	.....	.....	Calm.	Clear.	
	7 00	.....	27.702	67.0	66.2	58.5	65.5	66.0	.....	63.8	64.5	62.0	.....	.....	.....	SW. 1.	Clear.	
	9 00	.....	27.672	61.0	60.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	SW. 1.	Clear.	
	10 45	.....	27.680	57.0	58.0	.....	.....	55.0	.....	.....	.....	.....	.....	.....	.....	SW. 1.	Clear.	
Aug. 10,	5 00 A. M.	.....	27.668	47.0	50.0	46.8	46.0	46.0	.....	45.0	46.0	46.0	.....	.....	.....	SW. 1.	Clear.	
	7 00	.....	27.608	51.0	54.0	51.0	52.3	52.0	.....	51.0	58.8	50.5	.....	.....	.....	S.SW. 1.	Clear.	
	9 00	.....	27.612	70.0	62.3	57.2	65.2	64.5	.....	64.0	64.2	62.0	.....	.....	.....	Calm.	Cirrus 0.3.	
	11 00	.....	27.672	79.0	73.0	60.0	85.0	79.0	.....	74.0	80.0	105.0	.....	.....	.....	Calm.	Clear.	
	1 00 P. M.	.....	27.668	84.0	74.2	60.5	84.2	82.5	.....	80.0	81.5	99.5	.....	.....	.....	Calm.	Cirrus 0.2.	
	3 00	.....	27.634	81.5	83.3	61.0	92.6	88.5	.....	87.5	89.5	109.5	.....	.....	.....	NE. 2.	Cirrus 0.2.	
	5 00	.....	27.544	81.0	83.5	60.5	85.5	84.0	.....	82.0	83.8	84.0	.....	.....	.....	NE. 1.	.....	
	7 00	.....	27.543	71.5	70.7	.....	70.5	70.5	.....	69.0	69.0	68.5	.....	.....	.....	S. 1.	Cirrus 0.1.	
	9 05	.....	27.584	64.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	10 10	.....	27.519	62.3	.....	.....	.....	60.5	.....	.....	.....	.....	.....	.....	.....	SW. 2.	Str. 1.0.	Thunder.
Aug. 11,	5 10 A. M.	.....	27.532	56.0	56.0	52.0	55.5	56.0	.....	53.0	55.2	55.0	.....	.....	.....	.....	.....	Aneroid at 2 p. m., lower camp, by Mr. Engel, 27.715.
	7 00	.....	27.564	60.0	61.0	52.5	63.0	62.0	.....	61.0	62.5	63.0	.....	.....	.....	NE. 2.	Str.	
	9 00	.....	27.580	70.0	64.5	54.8	68.0	65.5	.....	64.5	65.0	.....	.....	.....	.....	SE. 2.	Str. 0.4.	
	11 00	.....	27.622	70.8	66.8	57.0	74.0	70.3	.....	73.5	73.0	82.0	.....	.....	.....	N. 2.	Str. 0.4.	Few drops of rain, 0.005.
	1 00 P. M.	.....	27.660	76.0	71.0	57.0	82.5	78.5	.....	73.5	75.8	100.0	.....	.....	.....	E. 1.	Str. 0.4.	Thunder.
	3 00	.....	27.668	68.0	68.2	58.0	75.0	70.0	.....	68.0	69.5	74.0	.....	.....	.....	S. 1.	Str. 0.5.	Sudden storm.
	5 00	27.608	27.702	67.0	69.5	59.5	71.8	69.8	.....	68.5	70.5	70.5	.....	.....	.....	SW. 1.	Str. 0.5.	Aneroid at 4 p. m., Observatory, 27.615. 68.8 deg.
	7 00	27.630	27.704	62.0	61.5	52.3	61.0	61.0	.....	60.0	61.5	57.0	.....	.....	.....	SW. 2.	Clear.	
	9 00	27.624	27.714	55.5	51.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	SW. 1.	Clear.	
	Midnight.	27.620	27.717	49.0	.....	.....	43.0	47.5	.....	.....	.....	.....	.....	.....	.....	Calm.	Fog.	Water, 27 698.
Aug. 12,	5 00 A. M.	27.639	27.726	46.0	46.5	44.0	43.0	.....	.....	42.8	43.2	45.5	.....	.....	.....	Calm.	Fog.	
	7 30	27.644	27.740	50.2	51.0	48.3	50.4	.....	.....	49.5	50.5	49.0	.....	.....	.....	NW. 1.	.....	
	9 00	27.640	27.732	69.0	58.0	52.5	60.4	.....	.....	58.0	58.5	56.0	.....	.....	.....	NE. 1.	.....	
	11 00	27.644	27.727	75.5	70.0	55.0	83.0	.....	.....	76.0	78.0	98.0	.....	.....	.....	NE. 2.	Clear.	
	1 00 P. M.	27.600	27.686	78.5	75.2	55.7	83.7	.....	.....	79.0	82.0	103.0	.....	.....	.....	NE. 3.	Clear.	
	3 00	27.552	27.642	77.8	78.0	55.0	87.5	.....	.....	82.4	82.3	98.0	.....	.....	.....	NE. 3.	Clear.	
	5 20	27.495	27.600	75.0	78.0	56.0	78.0	.....	.....	76.0	77.0	75.0	.....	.....	.....	NE. 2.	Clear.	
	7 15	27.480	27.588	67.0	66.5	56.0	63.5	.....	.....	62.5	63.0	62.0	.....	.....	.....	Variable.	Clear.	
	9 00	27.460	27.552	59.5	60.0	.....	57.0	.....	.....	.....	.....	.....	.....	.....	.....	SW. 1.	Clear.	

Meteorological observations—Continued.

CŒUR D'ALÈNE MISSION.

Date.		Aneroid.	Barometer.	Attached.	Detached, or dry.	Wet.	Black.	Naked.	OPEN AIR.				River.	Spring.	Rain.	Wind.	Clouds.	Remarks.
									4 ft. above.	1 ft. above.	¼ in. above.	Ground.						
1859.	h. m.			°	°	°	°	°	°	°	°	°						
Aug. 12,	11 00 P. M.	27.440	27.518	53.5	44.0	......	51.0	......	......	......	......	......	......	......	......	SW. 3.	Clear.	
Aug. 13,	1 00 A. M.	27.420	27.516	48.5	......	......	......	......	......	......	......	......	......	......	......	......	......	
	6 00	27.419	27.524	43.0	43.8	44.5	42.5	42.5	......	41.8	42.0	42.5	......	......	......	Calm.	Clear.	
	7 00	27.420	27.526	47.0	48.0	46.0	48.0	48.0	......	46.5	47.0	45.5	......	......	......	Calm.	Clear.	
	9 00	27.440	27.550	66.0	61.5	52.3	65.5	63.5	......	61.3	62.0	58.2	......	......	......	Calm.	Cir. st. 0.2.	
	11 10	27.463	27.550	76.0	71.5	54.5	78.8	78.0	......	76.5	76.5	99.0	......	......	......	NE. 2.	Cir. st. 0.2.	
	1 00 P. M.	27.438	27.542	80.3	75.6	53.5	86.3	80.7	......	81.0	83.0	101.0	......	......	......	SW. 3.	Cir. st. 0.4.	
	3 00	27.445	27.544	78.3	77.0	52.5	88.0	83.5	......	81.5	84.0	96.0	......	......	......	N NE. 3.	Cir. st. 0.1.	
	5 00	27.440	27.534	71.5	71.0	51.5	72.8	71.8	......	70.0	71.0	74.0	......	......	......	NW. 2.	Cir.	
	7 00	27.419	27.516	64.5	63.7	53.5	61.5	61.5	......	59.5	61.0	60.0	......	......	......	W. 1.	Cir. 0.8.	
	9 10	27.429	27.516	59.5	......	......	56.0	56.0	......	......	......	......	......	......	......	Calm.	Nim. 1.0.	
	11 10	27.460	27.560	60.5	......	......	60.5	60.5	......	......	......	......	......	......	......	NE. 2.	Rain.	
Aug. 14,	7 10 A. M.	27.562	27.692	50.0	50.5	45.0	49.0	48.0	......	47.5	49.5	51.0	......	......	0.05	Calm.	Cum. nim.	
	9 10	27.615	27.704	50.5	50.0	45.0	52.5	51.5	......	50.0	51.0	42.0	......	......	......	Calm.	Cum. nim.	
	11 10	27.640	27.690	60.0	54.3	51.5	58.5	56.3	......	53.8	55.0	62.0	......	......	......	Calm.	Cum. nim.	
	1 10 P. M.	27.670	27.696	64.0	60.0	49.5	65.5	62.0	......	61.0	62.0	72.0	......	......	......	SE. 2.	Stratus.	
	3 10	27.680	27.706	63.0	61.8	49.0	71.0	65.3	......	62.5	63.5	81.5	......	......	......	SE. 1.	Nimb. 0.5.	
	5 10	27.687	27.712	59.5	57.5	48.0	58.5	58.0	......	57.0	56.2	58.0	......	......	......	S. 3.	Nimb. 0.8.	
	7 10	27.685	27.718	56.5	53.0	47.8	50.0	50.0	......	49.5	50.0	50.5	......	......	......	SW. 2.	Nimb. 0.3.	
	9 10	27.696	27.766	49.0	......	......	......	......	......	45.0	45.0	......	......	......	......	SW. 1.	Nimb. 0.3.	
	11 10	27.700	27.762	44.7	......	......	42.0	42.0	......	......	......	......	......	......	......	SW. 1.	Clear.	
Aug. 15,	1 10 A. M.	27.704	27.769	42.0	......	......	38.3	38.5	......	......	......	......	......	......	......	W. 1.	Clear.	
	2 40	27.717	27.790	40.0	......	......	37.0	37.3	......	......	......	......	......	......	......	Calm.	Clear.	
	5 10	27.740	27.782	37.0	38.5	37.0	35.0	35.0	......	34.0	35.0	34.5	......	......	......	S. 1.	Foggy.	
	7 10	27.770	27.818	39.5	42.0	40.0	39.5	39.5	......	38.0	38.0	37.5	......	......	......	SE. 1.	Clear.	
	9 10	27.807	27.874	57.8	49.5	46.0	51.5	50.5	......	48.5	49.0	45.5	......	......	......	SW. 1.	Clear.	
	11 10	27.850	27.904	72.5	59.5	47.2	73.0	66.0	......	63.0	64.0	82.0	......	......	......	NW. 1.	Cirrus 0.1.	
	1 10 P. M.	27.860	27.912	75.5	65.0	50.0	70.5	72.5	......	70.0	72.0	100.5	......	......	......	Calm.	Cirrus 0.2.	
	3 00	27.852	27.954	68.5	67.0	50.2	84.0	77.0	......	73.5	76.0	103.5	......	......	......	Calm.	Cirrus 0.2.	
	5 00	27.830	27.942	66.0	70.0	57.0	68.0	68.0	......	65.8	67.5	68.0	......	......	......	S. 1.	Clear.	
	7 00	27.898	27.949	59.8	58.3	51.0	57.0	57.0	......	56.0	57.0	56.0	......	......	......	......	......	
	9 00	27.850	27.916	52.0	49.5	46.0	49.0	49.0	......	48.2	49.0	49.0	......	......	......	SE. 1.	Clear.	
	11 00	27.860	27.898	48.8	46.0	43.0	45.0	45.0	......	44.0	46.0	44.5	......	......	......	......	......	
Aug. 16,	1 00 A. M.	27.865	27.950	44.8	......	......	......	......	......	......	......	......	......	......	......	Calm.	Clear.	Northern light.
	3 05	27.835	27.964	41.0	41.5	39.0	38.3	38.5	......	38.0	38.0	......	......	......	......	E. 1.	Clear.	

	5 00	27.880	27.938	38.5	39.0	37.5	38.0	38.0	......	38.5	38.5	38.0	......	......	......	Calm.	Clear.	Foggy.
	7 25	27.886	27.938	42.5	45.0	42.0	45 5	45.0	......	44.0	44.0	44.5	......	......	......	SE.	Clear.	
	9 00	27.880	27.988	61.5	53 0	48.5	55.0	54.4	......	53.0	53.0	46.5	......	......	......	Calm.	Clear.	
	11 00	27.930	28.036	77.5	64 5	55.5	83 0	77.0	......	75.0	75.0	99.5	......	......	......	Calm.	Clear.	
	1 10 P. M.	27.950	28.032	76.8	70.3	51.5	90.8	84.0	......	78 0	78.0	94 5	......	......	......	S. 1.	Stratus.	
	2 15	27.945	28.028	76.0	73.3	53.6	85.2	79.8	......	79.0	79.0	97.0	......	......	......	S. 2.	Cum. 0.1.	
	5 00	27.878	28.000	71.8	74.3	56.5	74.0	73.2	72.3	72.5	72.5	71.2	......	......	......	S. SW. 1.	Clear.	
	7 00	27.876	27.998	65.5	66.0	53.5	63.3	63.5	62.5	61.3	61.3	61.0	......	......	......	S. SW. 1.	Clear.	
	9 00	27.878	27.954	56.0	56.5	47.5	54 0	54.0	51.8	53.0	53 0	54.5	......	......	......	S. SW. 1.	Clear.	
	11 00	27.880	27.966	52.2	51.0	45.5	48.0	48.0	48.8	48.0	48 0	49.0	......	......	......	E. 1.	Clear.	
Aug. 17,	1 00 A. M.	27.885	28.010	47.8	48.5	44.3	45.0	45 0	45.0	45 0	45.0	45.8	......	......	......	SE. 2.	Clear.	Halo around the moon.
	3 10	27.882	27.998	43.7	41.7	40.0	40 0	40.0	40.0	40.0	40.2	41.2	......	......	......	Calm.	Clear.	
	5 00	27.895	28.012	40.5	42.0	40.2	38.5	38.5	38.0	38.0	39.0	40.0	......	......	......	Calm.	Clear.	
	7 00	27.910	28.062	45.0	47.7	43.7	45.5	45.5	45.2	44.8	45.0	43.5	......	......	......	Calm.	Clear.	
	9 00	27.980	28.052	64.5	57.5	49.0	60.0	59.0	59.0	67.5	57.0	55.0	......	......	......	SE. 1.	Clear.	
	11 00	27.979	28.048	76.4	68.0	55.5	87.0	79.5	79.5	77.0	82.0	99.5	......	......	......	Calm.	Clear.	
	1 00 P. M.	27.955	28.052	81.5	75.3	57.5	95.0	88.5	88 5	86.0	93.0	104.0	......	......	......	S. 1.	Clear.	Max. 95 deg. All ther. in shade after 4.45 p. m. Dry, 55 deg.; wet, 50 deg.
	3 00	27.890	27.974	81.7	81.5	56.5	95 0	89.2	89.3	89.5	94.0	97.0	......	......	......	NE. 1.	Clear.	
	5 00	27.823	27.940	78 6	81.7	58.6	82.0	81 2	80.0	79.5	81.0	79.0	......	......	......	N. 1.	Clear.	
	7 00	27.795	27.898	70.5	71.6	57.0	69.0	69.0	68.5	67.0	66.5	66.0	......	45.5	......	Calm.	Clear.	
	9 30	27.770	27.838	56.8	58.0	50.5	......	......	58.0	......	......	......	......	......	......	SW. 1.	Clear.	
	11 00	27.760	27.828	56.0	55.0	49.0	......	......	54.0	......	......	......	......	......	......	Calm.	Clear.	
Aug. 18,	1 30 A. M.	27.720	27.850	51.2	51.5	47.0	48.0	48.0	48.0	......	......	......	......	......	......	Calm.	Clear.	
	4 00	27.686	27.818	46.7	48.0	45.0	43.0	43.0	...	......	......	43.0	......	......	......	S. 1.	Smoky.	
	7 00	27.704	27.842	46.0	48.5	44.0	46.0	46.0	45.8	45 5	46.0	46.5	......	......	......	....	Smoky.	
	9 00	27.738	27 838	70.0	57.8	50.5	61.5	60.5	59.5	58.5	58.8	58.5	......	......	......	Calm.	Smoky.	
	11 00	27.739	27.806	75.5	69.0	57.0	85.0	78.0	77.5	74.8	80.0	92.0	......	......	......	....	Smoky.	
	1 00 P. M.	27.728	27.808	82.8	80.0	59 8	97.5	91.0	90.0	89.5	94.0	106.0	......	......	......	....	Smoky.	
	2 00	27.695	27.788	85.0	84.0	59 6	95.5	90.3	92.0	90 0	100.0	116.0	......	......	......	....	Smoky.	
	3 00	27.672	27.772	85.2	83.5	62.0	96.5	92.0	93.0	90.7	97.0	109.0	......	45.5	......	S. 1.	Smoky.	Max. 96.5 deg.
	5 00	27.644	27.736	81.5	85.5	67.0	85.0	83.6	83.0	82.5	83.0	81.0	......	......	......	Calm.	Smoky.	
	7 00	27.600	27.704	70.5	71.7	56.7	70.0	70.0	68.0	68.0	67.5	67.0	......	......	......	S. 1.	Smoky.	
	9 00	27.579	27.638	62.4	61.8	52.8	......	......	60.0	......	......	......	......	......	......	S. 1.	Clear.	
	11 00	27.579	27.652	58 5	56.5	49.5	......	......	54.0	......	......	......	......	......	......	S. 1.	Clear.	
Aug. 19,	2 45 A. M.	27.565	27.668	49.5	51.0	......	47.0	47 0	46.5	......	......	......	......	......	......	Calm.	Smoky.	
	5 00	27.550	27.684	45.5	48.0	44.0	44.5	44.5	44.0	44.0	44.0	45.0	......	......	......	S. 1.	Cum. 0.3.	
	7 00	27.570	27.720	47.6	49.5	44.5	48.3	47.5	46.5	46.8	47.5	47.0	......	......	......	S. 1.	Cum. 0.3.	
	9 00	27.563	27.720	70.0	59.5	52.0	63.0	62 0	61.0	60.0	62.0	61.0	......	......	......	Calm.	Smoky.	
	11 00	27.670	27.736	78.5	69.5	55.5	83 0	78.5	78.0	77.0	81.0	88.0	......	......	......	Calm.	Smoky.	
	1 00 P. M.	27.660	27.728	83.5	81.0	57.5	91.0	86.8	85.0	85.0	89.0	96.5	......	......	......	S. SE. 3.	Smoky.	
	2 00	27.660	27.742	87.0	82.0	60.0	93.6	89.0	87.5	86.7	91.0	104.0	......	......	......	S. SW. 2.	Smoky.	
	3 00	27.640	27.734	83.0	82.3	59.8	92.0	87.8	86.0	86.3	90.0	97.0	......	......	......	W. 4.	Smoky.	Max. 92.5.
	5 00	27.639	27.730	80.5	82.0	57.5	83.0	82.5	80 8	81.0	82 0	79.5	......	......	......	W. 1.	Smoky.	
	7 00	27.619	27.716	76.0	77.0	56.5	77.0	77.0	75 0	75.0	74.5	71.5	......	......	......	Calm.	Clear.	
	9 00	27.618	27.676	62.0	61.0	51.5	58.0	58.0	57.0	......	......	......	......	......	......	Calm.	Clear.	
	11 00	27.610	27.660	57.0	53.5	49.5	51.5	52.0	51.0	......	......	......	......	......	......	Calm.	Clear.	
Aug. 20,	4 00 A. M.	27.643	27.738	47.5	48.5	......	44.0	44.0	43.0	......	......	......	......	......	......	Calm.	Clear.	
	5 30	27.667	27.774	46.7	49.5	47.0	45.2	45.3	44.8	44.8	46.0	45.0	......	......	......	Calm.	Clear.	
	7 00	27.720	27.774	50.0	53.0	49.5	50.8	50.5	50.0	49.0	49.0	48.0	......	......	......	Calm.	Clear.	
	9 00	27.779	27.846	70.0	65.0	54.5	65.5	65.5	64.0	64.0	64.0	56.0	......	......	......	E. 1.	Clear.	
	11 00	27.830	27.876	79.5	70.0	56 0	81.0	76.0	74 0	75.0	77.0	90 0	......	......	......	E. 1.	Clear.	
	1 00 P. M.	27.825	27.888	81.0	74.0	55.5	85.0	80.0	80.0	77.5	80.0	100.0	......	......	......	NE. 1.	Clear.	
	2 00	27.830	27.886	83.0	76.8	57.0	90.0	84.0	80.0	79.0	85.0	100.3	......	......	......	Calm.	Clear.	

Meteorological observations—Continued.

CŒUR D'ALÊNE MISSION.

Date.		Aneroid.	Barometer.	Attached.	Detached, or dry.	Wet.	Black.	Naked.	OPEN AIR.				River.	Spring.	Rain.	Wind.	Clouds.	Remarks.
									4 ft. above.	1 ft. above.	½ in. above.	Ground.						
1859.	A. m.			°	°	°	°	°	°	°	°	°	°					
	3 00	27.810	27.876	81.5	78.0	57.5	88.0	83.0	83.0	83.5	87.0	104.0	......	......	......	Calm.	Clear.	Max. 89°.
	5 00	27.760	27.885	76.7	78.7	58.0	79.2	78.4	77.6	77.0	78.0	76.7	......	......	......	W. l.	Smoky.	
	7 00	27.757	27.856	68.5	70.0	60.0	66.0	66.5	66.0	65.0	65.0	66.0	......	......	......	Calm.	Smoky.	
	9 00	27.759	27.846	60.5	61.5	52.0	57.0	57.0	57.0	57.0	57.5	56.5	......	......	......	SW. l.	Clear.	
Aug. 21,	5 00 A. M.	27.780	27.898	46.8	48.5	44.7	44.5	44.6	44.3	43.5	44.5	46.0	......	......	......	S. l.	Smoky.	
	7 00	27.818	27.896	48.5	52.0	47.5	49.5	49.0	49.0	48.5	47.5	48.5	......	......	......	S. l.	Smoky.	
	9 05	27.850	27.890	69.0	61.0	54.0	63.5	63.0	61.0	60.8	60.5	57.5	......	......	......	Calm.	Smoky.	
	11 00	27.890	27.976	85.0	70.0	58.0	98.0	82.5	81.0	79.0	83.0	94.0	......	......	......	Calm.	Smoky.	
	1 00 P. M.	27.886	27.970	87.5	79.0	57.5	97.0	91.8	88.0	87.0	91.5	104.0	......	......	...	Calm.	Smoky.	
	2 00	27.880	27.962	89.5	83.0	59.5	99.0	93.8	91.0	90.5	96.5	117.0	......	......	......	Calm.	Smoky.	
	3 00	27.879	27.942	88.5	85.0	61.5	100.0	95.0	93.0	93.0	98.5	111.5	......	......	......	Calm.	Smoky.	
	5 00	27.810	27.918	83.4	86.5	65.5	88.5	87.0	85.5	85.5	86.0	84.0	......	......	......	Calm.	Smoky.	
	7 00	27.780	27.884	73.0	72.5	59.0	70.5	70.5	69.0	68.0	67.8	67.0	......	......	......	Calm.	Smoky.	Max. 100.5 deg.
	9 00	27.778	27.860	66.0	66.0	56.0	63.5	63.5	62.0	62.5	63.0	62.0	......	......	......	S. l.	Smoky.	
Aug. 22,	5 06 A. M.	27.738	27.672	51.5	52.5	47.2	49.5	49.5	49.0	49.0	50.0	48.7	......	......	......	S. l.	Smoky.	
	7 00	27.750	27.868	52.5	53.3	48.0	52.5	52.0	51.0	51.0	52.0	52.5	......	......	......	S. l.	Smoky.	
	9 00	27.762	27.874	66.0	61.8	53.5	65.0	64.0	63.0	63.8	64.0	64.5	......	......	......	S. l.	Smoky.	
	11 30	27.752	27.868	87.0	75.5	62.2	92.3	87.5	87.0	86.5	92.5	105.0	......	45.5	......	S. l.	Smoky.	
	1 00 P. M.	27.747	27.782	93.0	81.9	62.5	104.5	99.5	97.0	93.5	101.0	105.0	......	......	......	Calm.	Smoky.	
	2 15	27.692	27.778	91.0	89.0	68.2	97.8	95.3	93.0	93.0	96.5	104.0	......	......	......	Calm.	Smoky.	Max. 102 deg.
	3 00	27.700	27.766	90.5	84.0	65.5	91.0	90.0	89.0	88.5	89.0	89.5	......	......	......	Calm.	Smoky.	
	5 00	27.645	27.742	81.0	79.0	63.0	81.5	81.5	80.0	80.0	81.0	80.0	......	......	......	S. l.	Smoky.	
	7 00	27.620	27.692	73.0	74.0	61.0	74.0	74.5	73.5	73.5	74.0	72.0	......	......	......	Calm.	Smoky.	
	9 05	27.610	27.688	69.0	68.5	58.5	67.0	67.0	66.0	67.0	68.0	65.0	......	......	......	NW. l.	Smoky.	
Aug. 23,	5 00 A. M.	27.619	27.660	62.0	63.0	58.0	60.0	59.5	59.8	60.0	60.5	59.5	......	......	......	SE. l.	Smoky.	
	7 00	27.610	27.692	61.5	62.8	59.0	59.5	61.0	61.0	61.5	61.0	61.0	......	......	......	S. l.	Smoky.	
	9 00	27.650	27.694	66.5	66.0	60.5	69.5	68.0	67.0	66.5	68.0	68.5	......	......	......	Calm.	Smoky.	Rain.
	11 00	27.675	27.732	70.5	69.5	61.5	72.0	71.0	70.8	70.0	71.0	70.0	......	......	......	Calm.	Str. 1.0.	
	1 00 P. M.	27.690	27.742	79.8	74.0	63.5	83.5	80.0	77.0	77.0	80.0	82.5	......	......	0.05	Calm.	Str. 1.0.	Rain.
	2 00	27.680	27.736	81.0	78.0	64.5	87.8	83.0	81.0	81.5	84.0	88.0	......	......	......	Calm.	Smoky.	
	3 00	27.666	27.736	78.5	77.0	64.5	86.0	81.8	80.0	81.5	85.0	88.0	......	......	......	Calm.	Smoky.	Max. 84 deg.
	5 00	27.656	27.746	74.5	74.5	60.5	75.5	74.5	73.0	73.5	74.5	74.0	......	......	......	Calm.	Smoky.	
	7 00	27.639	27.706	67.5	67.5	59.8	64.0	64.0	62.5	62.5	63.0	62.0	......	......	......	Calm.	Smoky.	
	9 00	27.640	27.726	62.5	64.0	57.0	58.5	59.0	58.0	59.0	60.0	......	......	......	......	S.	....	
	10 25	27.640	27.738	60.7	......	......	......	58.0	......	......	......	......	......	......	......	S. l.	Clear.	

Aug. 24,	6 00 A. M.	27.640	27.792	52.5	52.8	51.0	50.5	50.5	50.0	50.0	50.5	50.5	......	......	......	S. 1.	Clear.	
	7 00	[illegible]	27.730	53.8	55.3	50.6	53.7	54.9	54.0	54.0	55.6	54.0	......	......	......	Calm.	Smoky.	
	9 00	27.680	27.734	61.0	60.3	50.0	61.0	60.5	60.8	60.5	60.6	60 5	......	......	......	S.SE. 1.	Smoky.	
	11 00	27.786	27.756	76.0	68.5	60.0	80.5	75.0	75.0	73.9	75.5	78.5	......	......	......	Calm.	Smoky.	
	1 30 P. M.	27 790	27.772	78 5	74.0	60.5	81.0	77.5	77.0	78.5	82.5	92 0	......	......	......	Calm.	Str. 0.6.	
	3 00	27.660	27.778	76.0	76 2	64.0	84.9	80.7	79.0	80.8	86.0	97.3	......	......	......	SE. 1.	Str. 0.6.	Max. 83.5.
	5 15	27.660	27.778	74.0	75.0	62.5	75.0	74.5	72.0	72.5	74.0	75.0	......	......	......	S. 1.	....	Clearing up.
	7 10	27 640	27.736	65.5	66.0	60.5	63.5	63.8	62.0	62.0	63.0	63.0	......	......	......	Calm.	....	
	9 05	27.640	27.746	61.0	60.5	55.5	58.0	58.0	57.0	58.0	58.5	56.0	......	......	......	Calm.	Clear.	
Aug. 25,	6 00 A. M.	27.618	27.744	48.7	51.5	48.7	48.0	48.0	48.0	48.0	48.0	47.6	......	......	......	SW. 1.	Clear.	
	7 00	27.620	27.754	51.5	53.8	50.5	51.5	51.8	51.0	......	51.8	51.8	......	......	......	Calm.	Smoky.	
	9 00	27 660	27.760	65.0	60.8	55 5	63.0	62.5	62.5	61.0	62.0	61.0	......	......	......	N. 1.	Smoky.	
	11 05	27.700	27.756	82.5	70.4	59.5	89.0	83.0	83.0	80.0	83.5	87.0	......	......	......	Calm.	Smoky.	
	1 00 P. M.	27.699	27.756	85.8	79.0	61.0	91.0	86.5	86.5	84 5	88.0	100.0	......	......	......	Calm.	Smoky.	
	2 00	27.680	27.754	86.5	79.5	59.0	91.0	86.0	86.0	84.0	87.0	94.0	......	......	......	E. 1.	Smoky.	
	3 00	27.660	27.750	83.5	80.8	62.0	91.5	87.5	87.0	85.0	88.0	101.0	......	......	......	Calm.	Smoky.	Max. 92.5 deg.
	5 00	27.620	27.729	80.0	81.0	61.8	81.5	81.0	81.0	[illegible]	80.5	80.0	......	......	......	Calm.	Smoky.	
	7 00	27.565	27.642	69.8	69.8	61.0	66.0	66.8	66.8	64.0	66.0	64.5	......	......	......	Calm.	Smoky.	
	9 05	27.570	27.660	63 0	63.5	56.0	61.0	61.5	61.5	60.5	62.0	59.0	......	......	......	S.SW. 1.	Clear.	
Aug. 26,	5 15 A. M.	27.560	27.664	51.0	52 0	49.0	49.0	49 0	49.0	48.5	49.5	49.0	......	......	......	SE. 1.	Smoky.	
	7 00	27.580	27.672	52.0	52.5	50.0	51.5	51.0	51.0	50.0	51.5	52.0	......	......	......	S. 1.	Smoky.	
	9 00	27.610	27.664	67.0	60.0	53.5	62.0	61.5	61.5	59.5	61.5	62.0	......	......	......	Calm.	Smoky.	
	11 00	27.622	27.688	78.0	68.9	58.3	83.0	77 8	77.8	76.5	78.4	80.5	......	......	......	SW. 1.	Smoky.	
	1 00 P. M.	27.639	27.692	85.5	77.6	60.5	91.0	86.0	86.0	83.0	86.0	97.0	......	......	......	NW. 1.	Smoky.	
	3 00	27.600	27.688	84.5	79.8	61.0	94.0	89.0	89.0	87.5	90.0	100.0	......	......	......	N. 1.	Smoky.	Max. 92 deg.
	5 00	27.560	27.660	80.5	81.5	63.8	83.5	82.5	82.5	81.0	82.5	81.5	......	......	......	SW. 1.	Smoky.	
	7 00	27.540	27.646	70.5	72.0	62.0	70.0	70.0	70.0	68.0	68.5	67.5	......	......	......	Calm.	Smoky.	
	9 00	27.539	27.618	65.0	......	......	61.5	62.0	62.0	60.0	63.0	......	......	......	......	....	....	
	11 15	27.528	27.628	58 4	......	......	55.0	55.0	55.0	54.5	......	......	......	......	......	S. 1.	Clear.	Northern lights.
Aug. 27,	6 00 A. M.	27.540	27.680	47.0	48.5	46.0	44.5	45.8	45.8	45.0	45.0	46.0	......	......	......	S. 1.	Smoky.	
	7 10	27.580	27.686	49.5	50.0	57.0	49.5	49.0	49.0	47.0	48.5	49.5	......	......	......	Calm.	Smoky.	
	9 20	27.630	27.690	67.5	60.5	54.0	63 8	62.8	62.8	60.8	62.5	60.5	......	......	......	N. 1.	Smoky.	
	11 00	27.660	27.712	78.0	70.5	55.0	82.0	77.0	77.0	74 0	76.0	78.0	......	......	......	NE. 2.	Smoky.	
	1 05 P. M.	27.680	27.772	83.0	75.0	56.0	85.0	80.5	80.5	76.0	78.0	90.0	......	......	......	NE. 3.	Smoky.	
	2 00	27.679	27.764	83.5	77.5	58.5	87.0	82.8	82.5	80.0	83.0	98.0	......	......	......	NE. 2.	Smoky.	
	3 00	27.660	27.758	80.0	77.0	56.5	86.0	81.5	81.5	80.0	82.0	98.5	......	......	......	NE. 1.	Smoky.	
	5 00	27.640	27.744	77.0	77.8	58.0	78.5	77.8	77.8	76.0	77.5	76.0	......	......	......	E. 1.	Smoky.	Max. 87.8 deg.
	7 00	27.639	27.742	69.0	70.0	59.5	65.5	65.8	65.8	63.5	63.0	63.5	......	......	......	Calm.	Cirrus 0.1.	
	9 45	27.650	27.704	61.0	......	......	56.5	59.0	59.0	57.0	......	......	......	......	......	S. 2.	Clear.	
Aug. 28,	7 00 A. M.	27.730	27.868	49.0	52.0	48.0	49.0	49.0	49.0	48.0	47.8	48.0	......	......	......	SW. 2.	Smoky.	
	9 00	27.768	27.860	64.0	60.8	53.5	62.5	62.0	62 0	60.0	61.0	58.0	......	......	......	Calm.	Smoky.	
	11 05	27.820	27.876	82.0	68.5	58.5	91.0	84.0	84.0	80.5	83.5	82.0	......	......	......	Calm.	Smoky.	
	1 25 P. M.	27.824	27.872	87.0	76.5	59.0	95.0	89.8	89.8	84.5	89.0	107.0	......	......	......	Calm.	Smoky.	
	3 10	27.780	27.868	85.8	85.3	60.5	95.7	91.7	91.7	90.0	93.0	104.0	......	......	......	Calm.	Clear.	Max. 99.2 deg.
	5 00	27.756	27.844	83.0	86.0	65.5	87.0	86.0	86.0	83.5	84 0	84.0	......	......	......	Calm.	Clear.	
	7 00	27.730	27.832	71.0	72.3	59.0	68.5	70.0	70.0	68.0	67 5	67.0	......	......	......	Calm.	Clear.	
	11 45	27.750	27.818	58.8	58.5	52.0	55.0	55.0	55.0	54.0	54.5	54.5	......	......	......	S. 1.	Clear.	
Aug. 29,	5 00 A. M.	27.760	27.848	50.0	51.0	46.5	47.8	48.0	48.0	46.5	47.5	48.0	......	......	......	S. 1.	Smoky.	
	7 30	27.780	27.848	52.0	53.3	48.5	52.0	51.5	51.5	50.0	50.5	51.0	......	......	......	SW. 1.	Smoky.	
	9 05	27.805	27.838	65.0	60.0	53.0	63.0	62.0	62.0	60.0	61.5	61.5	......	......	......	Calm.	Smoky.	
	11 15	27.840	27.896	82.8	71.4	60.5	84.0	79.0	79.0	75.5	78.5	90.0	......	......	......	Calm.	Smoky.	
	1 05 P. M.	27.840	27.892	86.5	81.0	63.5	93.0	87.8	87.8	87.0	88.0	98.0	......	......	......	SE. 1.	Smoky.	
	2 00	27.820	27.890	88.5	83.5	64.8	98.0	93.5	93.5	89.0	91.0	103.0	......	......	......	Calm.	Smoky.	

Meteorological observations—Continued.

CŒUR D'ALÈNE MISSION.

Date.	Aneroid.	Barometer.	Attached.	Detached, or dry.	Wet.	Black.	Naked.	OPEN AIR. 4 ft. above.	OPEN AIR. 1 ft. above.	OPEN AIR. ½ in. above.	OPEN AIR. Ground.	River.	Spring.	Rain.	Wind.	Clouds.	Remarks.
1859. A. M.			•	•	•	•	•	•	•	•	•	•	•				
Aug. 29, 3 00 P. M.	27.810	27.886	87.5	85.0	64.0	94.5	91.0	91.0	88.0	89.0	97.0	......	......	......	Calm.	Smoky.	
5 05	27.770	27.868	89.0	85.5	57.0	85.0	84.8	84.8	83.0	83.5	81.0	......	......	......	E. 1.	Smoky.	Max. 97.5 deg.
6 50	27.750	27.844	71.0	70.8	57.5	65.5	66.0	66.0	63.0	63.0	64.0	......	......	......	S. 1.	Smoky.	
10 30	27.770	27.848	61.0	60.0	50.0	58.0	58.0	58.0	56.5	57.0	57.0	......	......	......	S. 2.	Smoky.	
Aug. 30, 5 30 A. M.	27.800	27.850	48.0	50.0	45.0	47.0	47.0	47.0	45.0	46.5	45.0	......	......	......	SE. 1.	Smoky.	
7 00	27.808	27.892	46.7	51.3	46.5	48.5	48.0	48.0	47.8	49.0	49.0	......	......	......	SW. 1.	Smoky.	
9 00	27.840	27.922	62.5	58.5	52.8	61.5	60.0	60.0	58.8	60.0	60.0	......	......	......	Calm.	Smoky.	
11 00	27.870	27.930	77.0	66.5	76.5	81.0	76.5	76.5	71.5	73.5	78.0	......	......	......	Calm.	Smoky.	
1 00 P. M.	27.880	27.932	90.5	81.0	63.8	100.5	95.0	95.0	87.5	90.0	106.0	......	......	......	Calm.	Smoky.	
2 00	27.860	27.918	89.5	80.0	61.5	101.0	97.5	97.5	93.0	95.0	105.0	......	......	......	Calm.	Smoky.	
3 00	27.844	27.936	86.0	86.0	63.5	96.0	91.5	91.5	86.0	90.0	98.0	......	......	......	Calm.	Smoky.	Max. 101.0 deg.
5 00	27.810	27.910	81.5	84.5	61.5	85.0	84.0	84.0	80.0	81.0	80.5	......	......	......	Calm.	Smoky.	
9 00	27.800	27.876	65.0	64.5	53.5	63.0	63.0	63.0	64.0	63.5	60.0	......	......	......	S. 1.	Smoky.	
10 15	27.810	27.894	62.0	61.3	51.0	59.0	59.5	59.5	58.0	59.5	57.5	......	......	......	S. 1.	Smoky.	
Aug. 31, 7 25 A. M.	27.844	27.896	52.0	52.5	47.5	51.5	51.0	51.0	50.0	51.0	52.0	......	......	......	Calm.	Smoky.	
9 00	27.878	27.936	64.5	56.5	52.0	62.5	61.0	61.0	59.5	60.5	62.0	......	......	......	Calm.	Smoky.	
11 00	27.899	27.954	76.5	68.0	57.0	80.8	76.0	76.0	73.0	74.0	79.0	......	......	......	Calm.	Smoky.	
2 00 P. M.	27.864	27.952	83.0	81.8	66.0	90.2	87.2	87.2	87.2	88.0	88.0	......	......	......	Calm.	Smoky.	Max. 92.0 deg.
4 00	27.839	27.918	84.0	82.0	70.5	86.0	87.0	87.0	83.0	85.0	86.5	......	......	......	Calm.	Smoky.	
6 00	27.790	27.882	74.5	75.5	66.0	73.0	73.0	73.0	71.0	71.0	71.0	......	......	......	Calm.	Smoky.	
9 25	27.788	27.830	65.0	64.0	56.0	62.0	62.0	62.0	61.0	62.0	60.0	......	......	......	S. 1.	Smoky.	
Sept. 1, 7 00 A. M.	27.760	27.860	52.0	53.5	49.3	52.0	51.5	51.5	50.5	52.0	52.0	......	......	......	S. 1.	Smoky.	
9 00	27.780	27.862	64.0	58.8	53.0	62.0	61.0	61.0	62.0	61.5	62.0	......	......	......	Calm.	Smoky.	
11 00	27.790	27.860	77.0	68.0	59.0	79.0	75.0	75.0	74.0	75.0	79.0	......	......	......	Calm.	Smoky.	
1 30 P. M.	27.760	27.854	83.5	79.0	63.0	87.0	84.0	84.0	81.5	84.0	96.0	......	......	......	Calm.	Smoky.	
3 50	27.720	27.824	85.0	84.5	66.0	93.0	90.0	90.0	86.0	89.0	93.0	......	......	......	Calm.	Smoky.	Max. 92.0 deg.
6 00	27.660	27.760	74.0	75.4	66.0	73.0	73.0	73.0	72.5	72.0	70.0	......	......	......	Calm.	Smoky.	
10 00	27.648	27.709	61.5	61.0	54.0	59.0	59.5	59.5	58.0	57.0	56.0	......	......	......	Calm.	Smoky.	
Sept. 2, 6 05 A. M.	27.630	27.710	49.0	54.8	48.0	48.0	48.0	48.0	47.0	48.0	48.0	......	......	......	S. 1.	Smoky.	
7 00	27.660	27.724	50.5	52.9	48.5	50.0	50.0	50.0	49.0	50.0	50.0	......	......	......	S. 1.	Smoky.	
9 00	27.650	27.702	60.0	57.0	52.5	59.0	58.0	58.0	58.0	59.0	60.0	......	......	......	Calm.	Smoky.	
11 00	27.670	27.758	71.5	65.5	58.0	74.0	71.0	71.0	68.0	70.0	73.0	......	......	......	Calm.	Smoky.	
1 30 P. M.	27.675	27.751	79.9	74.7	60.9	85.5	82.2	82.2	80.6	81.5	86.5	......	......	......	Calm.	Smoky.	Max. 81.5 deg.
4 10	27.692	27.738	79.0	78.9	68.5	81.5	80.5	80.5	79.6	80.0	80.5	......	......	......	Calm.	Smoky.	
6 00	27.570	27.694	73.5	73.0	66.0	76.5	71.0	71.0	68.0	69.0	69.0	......	......	......	Calm.	Smoky.	
9 00	[illegible]	[illegible]	[illegible]	63.0	56.5	59.0	60.0	60.0	60.0	......	59.0	......	......	......	Calm.	Smoky.	
Sept. 3, 7 00 A. M.	[illegible]	[illegible]	51.0	[illegible]	49.5	50.0	49.5	49.5	48.0	50.0	50.0	......	......	......	Calm.	Smoky.	

	9 00	27.690	27.760	68.0	67.0	59.0	60.0	58.0	66.0	58.5	58.0	60.0	......	......	......	Calm.	Smoky.	Four groups of solar spots; two of them seen through the smoke with the naked eye.
	11 00	27.690	27.774	74.5	67.0	57.5	77.0	74.0	74.0	72.0	74.0	78.0	......	......	......	NE. 2.	Smoky.	
	1 00 P. M.	27.710	27.760	77.0	79.0	59.0	[illegible]	79.8	79.6	79.0	[illegible]	[illegible]	......	......	......	N. 1.	Smoky.	
	2 00	27.705	27.760	77.0	73.0	58.0	82.5	80.0	80.0	79.0	80.0	86.0	......	......	......	N. 3.	Smoky.	
	3 00	27.700	27.756	76.0	73.5	59.0	81.0	78.5	78.5	76.5	76.0	81.0	......	......	......	NW. 2.	Smoky.	Max. 88.5 deg.
	5 10	27.700	27.762	69.0	68.8	55.0	70.0	70.0	70.0	68.0	69.5	69.0	......	......	......	NE. 2.	Smoky.	
	7 00	27.730	27.786	61.5	64.0	53.0	64.0	64.0	64.0	64.2	64.5	62 0	......	......	......	NE. 2.	Smoky.	
	10 00	27.760	27.816	61.2	60.5	51.0	59.0	59.0	59.0	57.5	58.0	58.0	......	......	......	N. 2.	Smoky.	Northern light.
Sept. 4,	6 15 A. M.	27.757	27 842	46.5	49 0	43.5	44.4	45.0	45.0	46.0	47.0	45.0	......	......	......	NE. 2.	Smoky.	
	7 00	27.770	27.900	49.5	50.4	44.4	48.5	48.5	48.5	48.0	48.0	47.5	......	......	......	NE 1.	Smoky.	
	9 00	27 785	27.912	61.8	58.2	48 5	61.2	60.3	60.3	60.0	60.5	58 5	......	......	......	E NE. 2.	Smoky.	
	11 00	27.805	27.852	74.0	73.8	51.0	75.5	76.0	76.0	70.0	73.0	75.0	......	......	......	W. 1.	Smoky.	
	1 00 P. M.	27.707	27.868	76.0	68.0	52.0	78.0	74.8	74.0	72.0	76.0	88.0	......	......	......	Calm.	Smoky.	
	2 00	27.780	27.856	77.5	70 5	53.5	80.0	78.0	78.0	76 5	80.0	93.0	......	......	......	NW. 1.	Smoky.	
	3 00	27 740	27.846	73.4	69.0	54.0	79.0	76.0	76.0	73.0	78.0	84.0	......	......	......	Calm.	Smoky.	Max. 80 deg.
	5 15	27.700	27.816	66.8	67.0	58.2	66.5	66.0	66.0	64.0	66.0	68.0	......	......	......	Calm.	Smoky.	
	7 00	27.685	27.730	60.0	60.5	52.0	58.5	59.0	59.0	58.0	57.5	56.0	......	......	......	Calm.	Smoky.	
	9 00	27.678	27.740	54.5	54.8	46.7	52 8	52.8	52.8	51.0	52.0	......	......	......	......	S. 1.	Smoky.	
Sept. 5,	7 00 A. M.	27.650	27.748	42 0	43.5	40.0	44.8	41.0	41.0	40.0	42.0	42 0	......	......	......	S 1.	Smoky.	
	9 00	27.670	27.742	54.5	51.0	45.0	54.0	53.0	53.0	51.0	52.5	53.0	......	......	......	Calm.	Smoky.	
	11 00	27.690	27.740	68.0	59.8	50.0	70.0	66.3	66.3	62.4	65.0	73.0	......	......	......	Calm.	Smoky.	
	1 00 P. M.	27.662	27.780	73.3	68.0	50.5	77.7	74.0	74.0	72.0	71.7	87.6	......	......	......	Calm.	Smoky.	
	2 00	27.660	27.756	77.0	71.0	56.0	82.0	79.0	79.0	76.0	78.5	86.0	......	......	......	Calm.	Smoky.	
	3 00	27.635	27.742	76.0	73.0	57.5	83.2	80.5	80.5	78.0	80.5	84.0	......	......	......	Calm.	Smoky.	Max. 81 2 deg.
	5 20	27.580	27.692	68 0	67.5	56.0	67.0	66.5	66.5	64.5	65.5	67.0	......	......	......	Calm.	Smoky.	
	7 00	27.560	27.674	62.0	61.0	52.0	60.0	60.0	60.0	58.5	59.5	58.2	......	......	......	S. 1.	Smoky.	
	9 00	27.563	27.636	57.5	58.0	50.5	56.8	57.0	57.0	56.0	57.0	55.0	......	......	......	S SW. 1.	Smoky.	
Sept. 6,	6 00 A. M.	27.600	27.654	53.0	53.0	48.0	52 5	52.5	......	51.5	52.0	52 0	......	......	......	Calm.	Smoky.	
	7 00	27.600	27.654	54.0	54.0	48.5	55.0	54.0	......	53.0	54.0	51.0	......	......	......	Calm.	Smoky.	
	9 00	27.590	27.646	59.5	56.5	51.5	59.0	58.0	......	57.0	57.5	59.0	......	......	......	S. 1.	Smoky.	
	11 00	27.580	27.698	66.4	63.0	54.0	74.4	71.3	......	70.0	72 5	76.0	......	......	......	Calm.	Smoky.	
	1 10 P. M.	27 580	27.646	77.0	67.5	57.0	85.0	81.5	......	79.0	80.5	91.0	......	......	......	Calm.	Smoky.	
	2 00	27.560	27.648	78.0	68.5	57.5	81.5	79.0	......	78.5	81 0	85.0	......	......	......	S. 1.	Smoky.	
	3 00	27.540	27.652	77.5	69.5	57.5	79.5	79.0	......	76.0	77.0	80.0	......	......	......	Calm.	Smoky.	Max. 86.0 deg.
	5 00	27.500	27.619	73.0	71.0	60.5	71.5	71.5	......	69.0	70.0	70.0	......	......	......	Calm.	Smoky.	
	7 00	27.490	27.574	67.5	64.5	55.8	65.0	65.4	......	64.0	65.0	63.0	......	......	......	Calm.	Smoky.	
	9 00	27.630	27.704	62.0	57.0	52.0	57.0	57.4	......	56.4	57.0	57.5	......	......	......	NE. 3.	Smoky.	Few drops of rain.
Sept. 7,	7 00 A. M.	27.605	27.708	51.0	49.4	47.5	49.0	48.6	......	48.0	49.0	51.0	......	......	......	Calm.	Smoky.	
	9 00	27.620	27.706	58.0	55.5	52.5	57.5	56.5	......	56.0	57.0	62.0	......	......	......	Calm.	Smoky.	
	11 05	27 629	27.714	58.5	56.0	52.0	58.0	57.0	......	55.5	56.8	60.0	......	......	......	E. 1.	Smoky.	
	1 00 P. M.	27.630	27.720	60 0	57.4	51.5	59.5	58.5	......	57.0	59.5	62.4	......	......	......	SW. 2.	Smoky.	
	2 00	27.639	27.722	61.8	58.0	52.8	61.5	60.0	......	58.0	60.0	65.0	......	......	......	N NE. 1.	Smoky.	
	3 05	27.639	27.720	60.5	56.0	52.0	58.0	57.3	......	56.0	57.5	60.0	......	......	......	E. 1.	Smoky.	Max. 73.0 deg.
	5 00	27 610	27 708	57.0	55.0	52.5	55.8	55.5	......	54.0	55.5	56.5	......	......	......	Calm.	Nimb.	
	7 05	27 620	27.726	55.8	55.0	52.5	54.0	54.0	......	53.0	54.0	54.0	......	......	......	Calm.	Str. 1.0.	
	9 00	27.604	27.720	56.0	54.4	52.0	53.8	53.8	......	53.0	54.0	54.0	......	......	......	Calm.	Str. 1.0.	
Sept. 8,	6 10 A. M.	27.560	27.644	53.0	52.4	47.0	52.8	52.8	......	52.0	52.5	52.0	......	......	......	SE. 2.	N. S. 1.0.	
	7 00	27.578	27.680	53.0	51.0	46.5	51.8	51.5	......	50.5	51.5	51.8	......	......	......	SE. 2	N. S. 1 0.	
	9 00	27.585	27.666	53.8	51.0	46.5	52.0	57.8	......	50.5	52.0	52.0	......	......	......	NW. 2.	N. S. 1.0.	Squally.
	11 00	27.589	27.668	57.0	54.0	47.5	56.5	55.8	......	54.0	55.8	58.0	......	......	......	NW. 2.	N. S. 1.0.	
	1 00 P. M.	27.684	27.600	64.2	58.3	51.0	63.0	61.0	......	60.7	63.0	68.5	......	......	......	W. 4.	N. S. 0.9.	Few drops of rain.
	2 00	....	27.680	69.2	60.5	53.5	66.0	63.4	......	62.7	66.0	79.0	......	......	......	W. 3.	N. S. 0.7.	
	3 00	....	27 680	63.2	60.5	51.7	71.0	66.5	......	66.0	66.3	80.0	......	......	......	W. 3.	N. S. 0.4.	Max. 76.5 deg.

Meteorological observations—Continued.

CŒUR D'ALÈNE MISSION.

Date.		Aneroid.	Barometer.	Attached.	Detached or dry.	Wet.	Black.	Naked.	OPEN AIR.				River.	Spring.	Rain.	Wind.	Clouds.	Remarks.
									4 ft. above	1 ft. above	½ in. above	Ground.						
1859.	h. m.			°	°	°	°	°	°	°	°	°	°	°	°			
Sept. 8,	4 10 P. M.	......	27.602	63.5	62.5	......	......	......	......	......	......	......	......	......	......	SW. 2.	N. S. 0.5.	
	5 00	......	27.656	62.5	60.5	51.8	62.2	62.0	......	61.2	63.0	64.0	......	......	......	SW. 1.	N. S. 0.7.	
	6 05	......	27.646	61.0	59.8	......	......	......	......	......	......	......	......	......	......	......	......	
	7 35	......	27.648	56.0	55.8	51.7	54.0	54.0	......	53.5	54.0	52.3	......	......	......	SW. 1.	N. S. 0.4.	
	10 40	......	27.644	48.0	46.5	44.0	45.0	45.0	......	44.0	46.0	48.0	......	......	......	Calm.	N. S. 0.9.	
Sept. 9,	5 00 A. M.	......	27.650	47.5	47.0	43.5	47.0	47.0	......	......	......	......	......	......	......	W. 2.	Nimb. 0.9.	Squally; raining.
	7 05	27.630	27.654	47.0	45.0	43.0	45.0	44.8	......	44.0	45.3	45.0	......	......	......	Calm.	Nimb. 1.0.	
	9 00	27.624	27.716	49.2	45.2	43.0	44.2	45.0	......	44.2	46.3	47.7	......	......	......	W. 1.	Nimb. 1.0.	Raining.
	11 05	27.660	27.714	49.0	47.5	45.8	45.5	46.0	......	45.5	47.0	50.2	......	......	......	Calm.	Nimb. 1.0.	Raining.
	1 00 P. M.	27.719	27.822	52.0	49.5	46.5	50.0	49.8	......	49.0	50.0	56.0	......	......	......	Calm.	Nimb. 1.0.	
	2 00	27.740	27.820	59.0	54.5	49.0	66.5	62.4	......	59.0	62.4	73.0	......	......	......	Calm.	Nimb. 0.3.	Max. 64.0 deg.
	3 00	27.742	27.828	57.0	54.8	49.5	61.4	59.5	......	57.8	62.0	63.0	......	......	......	SE. 1.	Nimb. 0.3.	
	5 00	27.750	27.824	55.0	55.5	51.0	56.0	55.0	......	53.5	54.5	54.0	......	......	0.10	NE. 1.	Cir. 0.2.	
	7 00	27.752	27.836	52.0	49.5	47.0	47.0	47.0	......	46.0	47.0	46.5	......	......	......	Calm.	Overcast.	At 6h. 30m. p. m., the aneroid taken to Col. Wright's camp of 1858. Reading at camp 27.840; observatory 27.740.
	9 10	27.772	27.860	46.0	47.2	44.8	43.6	43.7	......	43.2	45.0	43.7	......	......	......	S. 1.	Cum. 0.1.	
	11 25	27.802	27.878	40.3	45.5	43.5	40.8	41.0	......	......	......	......	......	......	......	Calm.	Cir. 0.2.	
Sept. 10,	6 00 A. M.	27.880	27.948	41.5	43.8	41.5	41.0	41.0	......	40.5	41.3	41.0	......	......	......	S. 1.	Cir. S. 0.1.	
	7 00	27.895	27.952	43.5	43.5	41.5	43.0	42.5	......	41.5	42.5	41.5	......	......	......	NW. 1.	Cir. S. 0.1.	
	9 00	27.930	27.966	49.0	46.8	44.0	48.0	47.5	......	46.0	47.0	47.0	......	......	......	Calm.	Cir. S. 0.4.	
	11 00	27.970	28.068	69.0	57.0	50.0	75.0	70.8	......	69.5	71.5	71.0	......	......	......	SE. 2.	Cum.	
	1 00 P. M.	27.938	28.043	72.0	63.8	52.5	77.0	74.0	......	71.5	74.0	86.0	......	......	......	N.NW. 3.	Cum.	
	2 00	......	28.018	76.8	65.0	55.0	76.0	73.0	......	......	74.0	......	......	......	......	N.NW. 3.	Clear.	
	3 00	......	28.000	70.0	65.8	51.5	78.0	75.0	......	......	75.0	......	......	......	......	NE. 2.	Clear.	
	5 00	......	27.970	69.0	67.8	54.5	69.8	69.0	......	......	69.0	......	......	......	......	NE. 1.	Clear.	
	7 00	......	27.942	59.5	59.0	51.0	56.0	56.5	......	......	55.5	......	......	......	......	S. 1.	Clear.	Max. 77.5 deg.
	9 10	......	27.946	53.8	54.4	47.0	49.8	50.0	......	......	49.5	......	......	......	......	Calm.	Clear.	
Sept. 11,	6 00 A. M.	......	27.960	40.0	42.3	41.0	39.8	39.8	......	......	38.5	......	......	......	......	S. 1.	Clear.	Aneroid at crossing 28.025; open plain 27.542; Mission peak 27.095; Wiessner's peak 23.960; Mission peak 16.780; crossing 27.842. See Appendix.
	7 00	......	27.964	41.8	45.0	42.5	42.5	42.5	......	......	41.5	......	......	......	......	S. 1.	Clear.	
	9 00	......	27.986	56.0	54.5	49.0	57.0	57.0	......	......	54.5	......	......	......	......	Calm.	Clear.	
	11 15	......	27.996	82.0	65.8	55.0	87.0	82.0	......	......	85.0	......	......	......	......	Calm.	Clear.	
	1 05 P. M.	......	27.962	86.5	78.2	59.8	98.0	93.0	......	......	92.5	......	......	......	......	Calm.	Clear.	
	2 00	......	27.932	85.0	72.8	56.0	102.0	98.0	......	......	96.5	......	......	......	......	Calm.	Clear.	
	3 00	......	27.904	83.3	84.4	62.0	103.0	98.0	......	......	94.8	......	......	......	......	Calm.	Clear.	
	5 00	27.760	27.826	79.0	84.0	60.5	83.8	83.0	......	80.0	82.0	79.0	......	......	......	Calm.	Clear.	Max. 106.0 deg.
	7 00	27.740	27.804	67.0	66.0	55.0	66.0	66.0	......	61.5	65.5	62.5	......	......	......	Calm.	Clear.	
	9 00	27.745	27.822	61.0	60.0	51.0	57.0	57.8	......	56.0	57.0	55.0	......	......	......	SE. 1.	Clear.	
	10 40	27.740	27.804	57.0	57.0	50.0	53.0	53.0	......	51.8	50.5	50.5	......	......	......	Calm.	Clear.	

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Aneroid.	Barometer.	Attached.	Detached.	Wet.	Ground.	Water.	Wind.	Clouds.	Remarks.
1859. h. m.				°	°	°	°	°			
Sept. 12, 2 00 A. M.	Cœur d'Aléne mission	27.724	27.850	49.8	51.0	48.0	......	......	S. SW. 1.	Clear.	
7 00	do.....do	27.750	27,850	45.0	49.0	44.8	43 8	......	Calm.	Clear.	
9 00	do.....do	27.764	27.900	60.0	57.0	51.0	54 0	......	Calm.	Clear.	
11 00	do.....do	27.819	27.900	83.0	71.4	55.0	89.0	......	Calm.	Clear.	
1 00 P. M.	do.....do	27.810	27.872	92.8	83.0	61.0	108.0	......	Calm.	Clear.	Black 107.0 deg. Naked 101.0 deg.
2 00	do.....do	27.790	27.870	92.5	86 0	63.0	110.5	......	Calm.	Clear.	Max. 106.0 deg.
3 05	do.....do	27.760	27.854	88.0	88.0	60.0	95.0	......	Calm.	Clear.	
5 00	do.....do	27.720	27.828	80.0	81.2	62.0	79.8	......	Calm.	Cir. 0.3.	
7 10	do.....do	27.690	27.7.8	68.5	......	......	......	......	Calm.	Cir. 0.3.	
9 00	do.....do	27.690	27.772	66.0	......	......	......	......	Calm.	Cir. 0.3.	
11 00	do.....do	27.680	27.760	61.0	......	......	......	......	Calm.	Cir. 0.3.	
Sept. 13, 1 15 A. M.	do.....do	27.650	27.780	56.5	......	......	......	......	SW. 1.	Cum. 1.0.	
7 00	do.....do	27.603	27.742	50.5	......	......	......	......	S. 1.	......	
9 00	do.....do	27 592	27.694	62 3	......	......	......	......	......	......	
1 20 P. M.	1st camp, 1.6 mile from mission	27.580	27.648	79.5	79.0	......	......	......	......	......	
3 00	do.....do	27.500	27.618	74.5	75.0	......	......	......	......	......	
5 05	At crossing of C. R	27 490	......	......	......	......	......	......	......	......	Rain 0.03 inches.
6 44	Gate at mission field	27.490	......	......	......	......	......	......	......	......	
9 00	1st camp, 1.6 mile from mission	27.520	27.572	72.5	72.0	......	......	......	......	......	Aneroid at Mission field gate, 7 h. 0 m., 27.644.
Sept. 14, 5 05 A. M.	do.....do	27.600	27.708	60.5	60.0	......	......	......	......	......	
6 20	do.....do	27.600	27.696	56.5	57.0	......	......	......	......	......	C. M. Transit stand, 9 15 27.582.
8 00	do.....do	......	27.722	57.5	57.0	......	......	......	......	......	Slack water below, 11 30 27.650.
9 15	do.....do	......	27.726	59.5	60.5	......	......	......	......	......	
11 00	do.....do	......	27.718	64.5	65.8	......	......	......	......	......	
Noon.	do.....do	27.628	27.706	66.4	68.0	......	......	......	......	......	
1 00 P. M.	do.....do	27.623	27.704	69.0	68.5	......	......	......	......	......	
2 00	do.....do	27.590	27.704	69.5	69 8	......	......	......	......	......	
3 00	do.....do	27.570	27.696	67.8	68.0	......	......	......	......	......	
4 00	do.....do	......	27.690	69.0	70.3	......	......	......	......	......	
5 00	do.....do	......	27.687	65.2	65.3	......	......	......	......	......	
7 05	do.....do	27.560	27.672	60.5	61.0	......	......	......	......	......	Rain 0.02 inches.
9 00	do.....do	27.550	27.646	57.0	59.0	......	......	......	......	......	Air near the water at 51.5 deg.
Sept. 15, 7 00 A. M.	do.....do	27.510	27.642	49.0	50.0	......	......	......	......	......	
8 00	do.....do	......	27.638	52.5	54.5	49.5	......	......	......	......	Air near the water at 56.0 deg.
9 00	do.....do	......	27.626	56.4	58.0	53.0	53.8	......	E. 2.	......	

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Aneroid.	Barometer.	Attached.	Detached.	Wet.	Ground.	Water.	Wind.	Clouds.	Remarks.
1859.	h. m.				°	°	°	°	°			
Sept. 15,	10 00 A. M.	1st camp, 1.6 mile above mission...	......	27.610	61.0	62.5	55.5	......	......	......	......	Air near the water at 61.5 deg.
	11 15	......do..........do........	......	27.606	58.0	69.3	......	......	......	......	......	
	1 35 P. M.	Level station, No. 11.	27.460	27.555	72.9	72.2	......	......	......	......	......	
	4 00	Camp 4 miles above mission........	27.435	27.525	63.5	......	......	......	......	......	......	
	6 15	......do.......... do..........	27.420	27.506	60.5	......	......	......	54.0	......	......	
	8 13	......do .... do..........	27.430	27.501	58.5	......	......	......	......	......	......	Rainy.
Sept. 16,	6 00 A. M.	......do..........do	27.434	27.545	55.5	......	......	......	......	......	......	Rainy.
	7 00	...... do..........do..........	27.450	27.534	57.0	59.5	......	......	......	......	......	Rainy.
	9 35	......do..........do..........	27.540	27.622	54.4	55.0	......	......	......	......	......	Rainy.
	11 00	......do..........do..........	27.550	27.628	57.0	57.3	......	......	......	......	......	Rainy, 0.40 inch.
	1 00 P. M.	......do..........do..........	27.562	27.642	59.5	60.5	......	......	......	......	......	
	2 00	......do..........do..........	27.570	27.640	59.0	59.5	......	......	......	......	......	
	3 00	......do..........do..........	27.582	27.660	56.5	57.4	......	......	......	......	......	
	5 00	......do..........do..........	27.606	27.690	55.3	56.0	......	......	53.0	......	......	Rain 0.03 inch.
	8 05	......do..........do..........	27.660	27.772	50.5	51.5	......	......	......	......	......	
Sept. 17,	7 00 A. M.	...... do..........do..........	27.878	27.999	43.5	45.0	......	......	......	......	Cum. N.0.3	
	9 15	......do.......... do..........	27.924	28.060	51.3	52.0	......	......	......	......	......	
	11 00	......do..........do..........	27.960	28.060	56.0	57.0	......	......	......	......	......	
	Noon.	...... do..........do..........	27.955	28.070	61.3	62.5	......	......	......	......	......	
	2 40 P. M.	...... do..........do..........	27.978	28.076	61.5	62.2	......	......	......	......	......	
	5 00	......do..........do..........	27.984	28.078	65.5	65.5	......	......	......	......	......	
	7 45	...... do..........do..........	27.979	28.068	44.3	46.3	......	......	......	......	......	
Sept. 18,	8 00 A. M.	...... do..........do..........	27.960	28.068	43.8	45.0	......	......	50.4	......	Clear.	
	10 00	......do..........do..........	27.929	28.018	49.0	51.0	......	......	......	E. 1.	......	
	Noon.	...... do.......... do..........	27.886	28.020	72.5	74.2	......	......	52.0	......	Cir. 0.1.	
	3 00 P. M.	... do..........do..........	27.859	27.964	82.0	83.5	......	......	......	......	Clear.	
	5 05	......do..........do..........	27.818	27.920	67.6	67.5	......	......	......	......	Clear.	
	8 15	......do..........do..........	27.779	27.832	45.0	48.0	49.0	......	53.5	......	Clear.	
Sept. 19,	6 00 A. M.	......do..........do..........	27.739	27.818	35.0	36.0	......	......	......	......	Clear.	Dew, 0.02.
	7 00	......do.......... do..........	27.730	27.830	35.8	36.5	34.5	......	50.0	Calm.	Clear.	
	8 00	......do..........do..........	......	27.837	39.5	41.5	......	......	......	......	......	
	9 05	...... do..........do..........	......	27.843	53.8	54.5	......	......	......	......	......	
	10 05	......do..........do..........	......	27.839	59.0	59.8	......	......	......	......	......	
	11 00	......do..........do..........	......	27.818	65.5	60.0	......	......	......	......	......	
	1 20 P. M.	Camp 7.5 miles above mission......	......	27.73[illegible]	79.5	81.0	......	......	......	......	......	

	9 05	do	do	27.620	27.742	[illegible]	84.0						
	3 00	do	do		27.730	79.8	79.0						
	4 00	do	do		27.720	74.0	75.0						
	5 30	do	do	27.580	27.682	63.5	63.5						
	8 00	do	do	27.570	27.638	51.8	52.5					1 0.	
	9 00	do	do	27.560	27.620	47.8	49.0					1.0.	
Sept. 20,	7 00 A. M.	do	do	27.538	27.687	43.0	44.3						
	8 00	do	do		27.661	45.5	46.5						Thunder.
	9 00	do	do		27.680	47.4	48.0						Rainy.
	10 00	do	do		27.720	49.0	50.0						Rainy, 0.09 inch.
	Noon.	Mud Prairie camp, 9.5 miles from mission		27.610			60 0						
	1 30 P. M.	do	do	27.599	27.676	60.0	60.5						
	5 15	do	do	27.539	27.626	60.0	60.5						
	7 20	do	do	27.500	27.600	54.5	55.0					1.0.	Rainy.
Sept. 21,	6 10 A. M.	do	do	27.336	27.406	54.8	56.5				Calm.		Rainy, 0.55 inch.
	7 05	do	do	27.340	27.420	55.0	56.0					1.0.	Rainy.
	8 15	do	do	27.343	27.436	56.0	56.0					1.0.	Rainy, 0.15. inch.
	10 10	do	do	27.378	27.440	60.5	61.8					1.0.	
	11 15	do	do	27.370	27.446	63.0	64.5					1.0.	
	1 00 P. M.	do	do	27.377	27.452	62.7	65.5		51.0			1.0.	
	2 00	do	do	27.407	27.477	60.5	59.3				W. 4.	1.0.	
	3 10	do	do	27.423	27.458	61.0	63.0				Calm.	1.0.	Rainy, 0.02 inch.
	4 00	do	do	27.439	27.552	61.8	62 0				Calm.	1.0.	
	5 10	do	do	27.449	27.546	57.4	58 0				Calm.	1.0.	
	8 25	do	do	27.460	27.512	52.8	54 0				Calm.	1.0.	Rainy.
Sept. 22,	6 50 A. M.	do	do	27.517	27.642	53.0	54.0		49.5	0.09			
	9 10	do	do	27.568	27.654	50.0	51.0					Nimb. 1.0.	
	11 10	do	do	27.620	27.704	50.8	52.0					Nimb. 1.0.	
	1 00 P. M.	do	do	27.680	27.714	51.8	52.8						Rainy.
	2 00	do	do	27.688	27.778	54.5	56.3			0.18			Rainy.
	3 10	do	do	27.770	27.794	55.0	56.0						Rainy.
	4 00	do	do	27.720	27.794	52.0	53.4			0.02			Rainy.
	5 20	do	do	27.745	27.824	52.8	53.5					Nimb. 1.0.	
	6 00	do	do	27.764	27.832	50.2	51.0		49.5				
	7 50	do	do	27.786	27.862	48.0	48.5						Foggy.
Sept. 23,	6 25 A. M.	do	do	27.859	27.930	46.0	47.0					Nimb. 1.0.	
	8 00	do	do	27.853	27.936	44.5	45.2			0.01			Rainy.
	9 00	do	do	27.810	27.931	48.5	50.0						
	10 00	do	do	27.825	27.936	51.7	53.0						
	11 00	do	do	27.820	27.902	50.0	52.0						
	1 00 P. M.	do	do	27.790	27.896	58.0	59.0						
	3 00	do	do		27.888	60.0	60.5						
	4 00	do	do		27.820	60.0	60.0						
	7 10	Camp 11 miles above mission		27.714	27.794	45.0							Rainy.
Sept. 24,	6 00 A. M.	do	do	27.678	27.767	45.3			48.0	0.05			Rainy.
	7 05	do	do	27.680	27.758	46.0							
	8 00	do	do	27.683	27.756	49.5							Clearing up.
	9 00	do	do	27.692	27.763	54.0							
	10 00	do	do	27.700	27.764	64.0							
	11 00	do	do	27.718	27.818	71.0							
	Noon.	do	do	27.700	27.793	72.3							
	1 00 P. M.	do	do		27.798	67.5							

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Aneroid.	Barometer.	Attached.	Detached.	Wet.	Water.	Rain.	Wind.	Clouds.	Remarks.
1859.	A. m.				•	•		•				
Sept. 24,	2 07 P. M.	Camp 11 miles above mission		27.768	67.8	69.0						
	3 00	......do............do		27.766	68.0	68.5						7.5 feet above water.
	4 34	Camp 14 miles above mission	27.622	27.692	69.2	62.0				Calm.	0.2.	6 feet above water.
	6 20	......do............do	27.620	27.692	52.8					Calm.	Clear.	
	9 45	......do............do	27.640	27.678	46.0					Calm.	Clear.	
Sept. 25,	7 10 A. M.	Camp 13.5 miles above mission	27.600	27.687	47.0			47.5			Fog.	
	8 30	......do............do	27.608	27.692	50.8							
	9 00	......do............do	27.602	27.688	54.0							
	10 00	......do............do		27.690	61.0							
	11 10	......do............do		27.694	64.0							
	0 05 P. M.	......do............do		27.684	65.5							
	1 10	......do............do		27.686	64.0				0.09			Rainy; thunder.
	3 00	......do............do		27.680	66.0							
	4 10	......do............do		27.664	60.0							
	5 00	......do............do	27.579	27.664	57.5							
	7 50	......do............do	27.530	27.644	51.0							
Sept. 26,	6 20 A. M.	......do............do	27.490	27.613	47.5						Fog.	
	7 40	......do............do	27.497	27.614	50.5							
	8 55	......do............do	27.517	27.696	53.0							
	0 22 P. M.	Camp 16.3 miles above mission	27.443	27.523	67.7	67.3				Calm.	Cum. 0.3.	
	1 10	......do............do	27.419	27.494	67.5	66.9						
	2 25	......do............do	27.399	27.490	72.5	72.0						
	4 25	......do............do	27.397	27.492	62.4	63.0				W. 2.	Nimb. 1.0.	
	8 35	......do............do	27.362	27.460								Raining.
Sept. 27,	7 40 A. M.	......do............do	27.262	27.350	52.5	52.0						Raining.
	9 00	......do............do	27.239	27.340	52.3	52.0						Raining.
	10 20	......do............do	27.210	27.322	53.5	52.5			0.71			Raining.
	2 00 P. M.	......do............do	27.250	27.392	74.8*	54.0						Raining.
	4 00	......do............do	27.230	27.378	66.3*	53.0						Clearing up
	9 45	......do............do	27.340	27.434	60.0*	48.0						Raining.
Sept. 28,	7 25 A. M.	......do............do	27.408	27.524	42.7	42.5						Raining.
	9 00	......do............do	27.432	27.566	60.5*	44.5			0.15			Raining.
	1 00 P. M.	......do............do	27.500	27.601	65.7*	51.7			0.03			Raining.
	4 30	......do............do	27.502	27.615	61.4*	48.7		48.0				
	9 30	......do............do	27.510	27.586	54.5	42.0						

Sept. 29,	7 00 A. M.	do.......do	27.878	[illegible]	[illegible]	39.5						Raining.
	9 15	do.......do	[illegible]	[illegible]	50.5*	42.0			00.2			Raining.
	11 19	do.......do	27.690	27.708	61.0*	40.2						Raining.
	1 05 P. M.	do.......do	27.618	27.704	58.0*	47.0			0.06			Raining.
	3 00	do.......do	27.610	27.710	59.0*	44.5						Raining.
	5 00	do.......do	27.608	27.700	48.5*	43.0			0.01			(* Artificial temperatures.)
	9 20	do.......do	27.681	27.760	56.0*	41.5						
Sept. 30,	7 00 A. M.	do.......do	27.783	27.904	46.5	43.0						
	8 05	do.......do	27.818	27.906	49.5							
	9 13	do.......do		27.916	46.0	45.0						
	10 00	do.......do		27.914	48.0	48.6						
	2 00 P. M.	Rest, 19 miles above mission	27.733	27.824	56.0	56.0						
	3 00	do.......do		27.820	55.5	56.0						10 feet above water.
	4 34	Camp, 20 miles above mission	27.725	27.800	56.0	57.5						
	7 00	do.......do	27.730	27.802	55.0	50.5						
	8 00	do.......do	27.740	27.792	54.0	47.5						
Oct. 1,	7 00 A. M.	do.......do	27.747	27.843	43.7	41.8						
	9 00	do.......do	27.760	27.874	54.0	51.5						
	11 00	do.......do	27.735	27.846	67.5	64.5					Clear.	
	1 00 P. M.	do.......do	27.749	27.838	73.0	66.0				SW. 2.		
	3 08	do.......do	27.742	27.810	64.0	59.5					Cir. 0 8.	
	5 00	do.......do	27.700	27.780	57.5	53.8						
	11 06	do.......do	27.633	27.742	51.0	41.0					Clear.	
Oct. 2,	7 00 A. M.	do.......do	27.510	27.614	....	38.0					Fog.	
	8 00	do.......do	27.498	27.632	49.6	41.0						
	9 00	do.......do		27.608	62.3	49.8						
	10 00	do.......do		27.610	69.0	59.5						
	11 00	do.......do		27.622	73.0	61.0						
	Noon.	do.......do		27.604	75.0	63.6						
	1 00 P. M.	do.......do		27.582	77.0	68.0						
	2 00	do.......do		27.520	75.0	66.0						
	4 00	do.......do		27.470	59.0	55.9						
	7 00	do.......do		27.461	51.0	48.0						
	8 45	do.......do		27.434	52.5	45.0						
Oct. 3,	6 40 A. M.	do.......do		27.372	46.5	35.4						
	8 00	do.......do		27.366	51.0	47.5						
	9 05	do.......do		27.372	54.5	50.8						
	10 12	do.......do		27.374	60.8	59.5						
	11 13	do.......do		27.374	59.0	57.5						
	3 00 P. M.	16th crossing		27.210	53.4	53.0						6 feet above water.
	5 45	Camp, 25 miles above mission		27.192	51.0	50.0						4 feet above creek.
	7 20	do.......do		27.162	48.0	47.0						Raining.
Oct. 4,	7 00 A. M.	do.......do		27.324	36.4	34.5						
	8 10	do.......do		27.338	36.5	35.4						
	9 00	do.......do		27.360	37.0	36.5						
	11 00	do.......do		27.348	50.5	51.0						
	1 05 P. M.	do.......do		27.348	59.0	58.0						
	1 30	do.......do	27.143	27.348	62.0	57.0						
	3 00	do.......do		27.348	...	.....						
	7 25	Long prairie		26.780	39.0	39.0						
	8 00	do.......do		26.766	34.5	..						
Oct. 5,	7 20 A. M.	do.......do		26.708	29.7	26.0		41.5				In washbasin half inch ice.
	8 30	do.......do		26.718	40.8	38.0						

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Aneroid.	Barometer.	Attached.	Detached.	Wet.	Water.	Rain.	Wind.	Clouds	Remarks.
1859. *h. m.*				°	°		°				
Oct. 5, 11 00 A. M.	47th crossing		26.378	43.3							Foot of divide.
2 00 P. M.	Road turning to the left		25.851	50.7							West entrance to tunnel.
3 00	do do		25.848	51.0							
4 00	do do		25.850	52.3							
8 05	do do		25.860	48.8							
Oct. 6, 7 09 A. M.	do do		25.960	38.0							
9 10	do do		26.004								
11 18	do do		26.028	44.0							
12 03	do do		26.012	46.0							
4 03 P. M.	Sohon's Pass		25,214	47.5					Calm.	Clear.	
6 40	do do		25.205	39.6					Calm.	Clear.	
7 50	do do		25.188	40.8					Calm.	Overcast.	
Oct. 7, 1 00 A. M.	do do		25.223	43.5					Calm.	Overcast.	
6 30	do do		25.310	44.5							
8 00	do do		25.292	48.0			39.0				Spring.
9 15	do do		25,292	52.0							
11 00	do do		25 316	59.0							
1 20 P. M.	do do		25.310	57.0							
6 00	do do		25,262	58.0					Calm.	Clear.	
10 00	do do		25.224	47 0					Calm.	Clear.	
11 15	do do		25.242	48.3					SW. 2.	Clear.	
Oct. 8, 6 30 A. M.	do do		25.229	46.2					SW. 2.	Overcast.	
8 20	do do		25.230	45.0					Calm.	Overcast.	
11 00	do do		25.231	42.7					Calm.	Overcast.	Raining.
1 00 P. M.	do do		25.221	44.5				0,03	SW. 2.	Nimb, 0.8.	
3 05	do do		25.220	42.0					S.SW. 2.	C. C. 0.3.	
4 50	do do		25.220	37.0					E. 1.	Clear.	
8 40	do do		25.198	37.0					W. 3.	Clear.	
11 00	do do		25 186	30.0					Calm.	Clear.	
Oct. 9, 7 00 A. M.	do do		25,272	24 5					Calm.	Clear.	
8 00	do do		25.260	30 0					Calm.	Clear.	
10 00	do do		25.272	39.0					Calm.	Clear.	
Noon.	do do		25.266	39.5					Calm.	Clear.	
2 15 P. M.	do do		25.262	46 0					Calm.	Clear.	
3 10	do do		25.258	43.0					Calm.	Clear.	

Meteorological observations—Continued.

SOHON'S PASS.

Date.	Aneroid.	Barometer.	Attached.	Detached.	Wet.	Black.	Naked.	Spring.	Rain.	Wind.	Clouds.	Remarks.
1859. h. m.			°	°	°	°	°	°				
Oct. 9, 4 05 P. M.	....	25.254	38.0	.....	.....	.....	.....	.....	.....	....	....	
6 30	....	25.226	30.8	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
9 00	....	25.192	31.5	.....	.....	.....	.....	.....	.....	NW. 1.	Overcast.	
11 15	....	25.148	29.0	.....	.....	.....	.....	.....	.....	SW. 2.	Clear.	
Oct. 10, 6 55 A. M.	....	25.137	25.5	.....	.....	.....	.....	.....	.....	W.NW. 1.	Clear.	
8 30	....	25.138	30.5	.....	.....	.....	.....	.....	.....	SW. 2.	Overcast.	
10 00	....	25.138	35.5	.....	.....	.....	.....	.....	.....	SW. 2.	Overcast.	
11 30	....	25.126	41.5	.....	.....	.....	.....	.....	.....	SW. 3.	Overcast.	
2 00 P. M.	....	25.090	42.5	.....	.....	.....	.....	.....	.....	SW. 3.	Overcast.	
3 30	....	25.086	38.0	.....	.....	.....	.....	.....	.....	SW. 3.	Overcast.	
5 00	....	25.060	36.8	.....	.....	.....	.....	.....	.....	SW. 3.	Overcast.	
7 00	....	25.050	34.8	.....	.....	.....	.....	.....	.....	Calm.	Overcast.	
Oct. 11, 0 45 A. M.	....	25.012	28.0	.....	.....	.....	.....	.....	.....	Calm.	Clear.	
1 50	....	24.996	27.6	.....	.....	.....	.....	.....	.....	N. 1.	Overcast 0.5.	Dry and wet bulb in observatory.
6 45	....	25.000	32.5	.....	.....	.....	.....	.....	.....	NE. 1.	Overcast 1.0.	Black and naked outside on the roof, and are wet bulbs in rainy or snowing weather.
9 00	....	25.020	39.8	40.3	38.0	42.0	40.4	.....	.....	SW. 1.	Overcast.	
11 12	....	25.014	47.8	48.0	42.0	51.8	48.5	.....	.....	SW. 2.	Overcast.	
1 07 P. M.	....	25.002	45.5	41.8	.....	46.0	43.8	.....	.....	....	....	
3 23	....	24.988	38.0	39.0	38.0	36.0	35.0	.....	.....	....	....	Raining and snowing.
5 07	....	24.956	37.0	37.0	36.0	34.8	34.3	.....	.....	....	....	Raining and snowing.
7 45	....	24.929	36.8	38.0	36.0	.....	.....	.....	.....	E. 3.	Overcast.	Rain.
Oct. 12, 7 18 A. M.	....	25.004	32.7	31.3	32.7	32.0	31.3	.....	0.50	W.SW. 3.	Overcast 0.6.	During night raining and snowing.
9 00	....	25.018	34.0	34.4	33.0	34.0	33.4	.....	.....	W.SW. 3.	Overcast 0.6.	
11 00	....	25.063	35.5	36.0	34.0	35.0	34.0	.....	.....	....	....	Snowing 1-5 inch.
3 00 P. M.	....	25.076	35.0	35.8	34.4	32.5	31.5	.....	0.02	....	....	Snowing 1-5 inch.
5 00	....	25.098	35.0	35.0	34.0	31.5	30.8	.....	.....	W.SW. 2.	Cum. 0.1.	
7 40	....	25.120	32.0	32.2	31.5	28.0	27.3	.....	.....	W.SW. 3.	Cum. 0.2.	
10 00	....	25.102	31.0	31.0	30.0	25.5	25.5	.....	.....	W SW. 3.	Cum. 0.2.	
11 00	....	25.128	30.4	30.0	29.0	25.8	29.8	.....	.....	W.SW. 3.	Cum. 0.2.	
Oct. 13, 3 00 A. M.	....	25.151	27.2	29.5	28.2	23.0	22.0	.....	.....	Calm.	Clear.	
6 45	....	25.188	24.0	25.5	.....	20.5	19.5	.....	.....	Calm.	Clear.	Ice ¾ inch thick.
9 00	....	25.204	30.7	29.5	.....	99.3	27.8	.....	.....	Calm.	Clear.	
11 00	......	25.240	37.0	35.3	31.7	36.0	33.7	.....	.....	Calm.	Clear.	
1 00 P. M.	....	25.228	41.0	41.0	37.8	44.0	41.5	.....	.....	Calm.	Clear.	
2 00	....	25.216	40.5	42.4	37.5	49.0	46.3	.....	.....	Calm.	Clear.	

Meteorological observations—Continued.

SOHON'S PASS.

Date.		Aneroid.	Barometer.	Attached.	Detached.	Wet.	Black.	Naked.	Spring.	Rain.	Wind.	Clouds.	Remarks.
1859	h. m.			°	°	°	°	°	°	°			
Oct. 13,	3 00 P. M.	....	25.232	39.0	42.0	37.8	50.0	45.5	.....	.....	Calm.	Clear.	
	5 00	....	25.228	35.0	36.0	34.0	35.0	33.8	.....	.....	Calm.	Clear.	
	7 00	....	25.206	32.5	36.0	31.0	31.0	30.5	.....	.....	Calm.	Clear.	
Oct. 14,	0 50 A. M.	....	25.202	28.2	29.5	28.3	25.8	25.4	.....	.....	Calm.	Clear.	
	2 00	....	25.156	27.5	30.0	28.7	24.0	23.5	.....	.....	Calm.	Clear.	
	4 15	....	25.188	27.7	29.5	......	21.8	24.0	.....	.....	Calm.	Clear.	
	7 25	....	25.192	28.3	29.0	28.0	27.2	26.2	.....	.....	Calm.	Clear.	
	9 04	....	25.176	35.0	33.0	30.8	37.0	35.5	.....	.....	Calm.	Clear.	
	11 05	....	25.178	42.7	41.5	36.0	54.0	49.5	.....	.....	W.SW. 3.	Cir. 0.8.	
	1 00 P. M.	....	25.146	46.3	47.0	39.8	51.0	48.6	.....	.....	W.SW. 3.	Nimb. 1.0.	
	2 00	....	25.110	46.5	46.5	40.0	51.0	48.8	.....	.....	W.SW. 5.	Nimb. 1.0.	
	3 06	....	25.124	47.0	46.5	41.0	50.4	48.0	.....	.....	....	....	
	5 00	....	25.085	46.0	45.3	41.5	46.0	45.2	.....	.....	W. 2.	Nimb. 1.0.	
	7 00	....	25.013	43.5	43.0	39.2	41.5	40.7	.....	.....	W. 2.	Clear.	
	8 35	....	24.998	45.3	45.2	41.3	43.5	42.5	.....	.....	W. 2.	Clear.	
Oct. 15,	1 45 A. M.	....	24.824	46.3	44.8	41.8	45.5	44.8	.....	.....	S.SW. 3.	Overclouded.	
	2 40	....	24.828	46.3	46.0	41.3	45.0	44.5	.....	.....	W. 3.	Overclouded.	Rain.
	7 45	....	24.693	40.0	40.3	40.0	40.0	39.7	.....	0.72	W.SW. 4.	Overclouded.	
	9 00	....	24.744	38.0	38.7	37.8	36.5	35.5	.....	.....	W.SW. 4.	Overclouded.	
	11 00	....	24.740	37.0	37.5	35.8	39.0	36.8	.....	.....	W.SW. 4.	Overclouded.	
	1 00 P. M.	....	24.776	37.0	40.0	37.5	41.0	42.0	.....	.....	W.SW. 3.	Overclouded.	
	2 00	....	24.780	38.0	39.5	37.0	41.5	39.0	.....	.....	W.SW. 3.	Overclouded.	Snowing.
	3 00	....	24.780	37.0	37.8	36.0	38.8	35.5	.....	.....	W.SW. 3.	Overclouded.	Snowing.
	5 00	....	24.784	33.0	34.0	32.5	30.0	28.5	.....	.....	W.SW. 2.	Overclouded	Snowing.
	7 00	....	24.772	32.5	33.5	32.0	30.5	29.3	.....	.....	W.SW. 2.	Overclouded.	
	8 00	....	24.804	33.0	34.0	32.8	30.0	29.0	.....	0.14	W.SW. 2.	Overclouded.	Snowing 1½ inch.
Oct. 16,	7 00 A. M.	....	24.862	24.7	26.2	25.7	22.7	22.5	.....	.....	....	....	
	9 15	....	24.900	25.3	26.0	25.5	25.0	24.5	.....	.....	W.NW. 2.	Cir. Cum. 0.8.	
	11 00	....	24.924	30.5	30.5	29.0	32.4	30.0	.....	.....	W.NW. 3.	Overcl'd 0.9.	
	2 00 P. M.	....	24.936	30.0	29.5	28.5	27.8	26.5	.....	.....	....	....	Snowing.
	3 00	....	24.938	29.8	29.5	28.8	27.5	26.8	.....	0.11	....	....	Snowing 1 1-5 inch.
	5 00	....	24.950	28.0	......	......	26.5	26.0	.....	.....	....	Clear.	Snowing 1 1-5 inch.
	6 45	....	24.972	27.8	30.5	29.7	27.5	27.3	.....	.....	Calm.	Clear.	For about 10 minutes.
Oct. 17.	6 30 A. M.	....	24.984	26.0	27.5	27.3	23.3	24.7	.....	0.07	....	Overclouded.	During the night, and snowing.
	9 00	....	24.980	30.0	30.5	29.5	30.5	29.0	.....	.....	....	....	Snowing ¾ inch.
	11 25	....	24.950	33.0	33.3	30.5	33.0	31.5	.....	.....	SE. 1.	Overcast.	

	1 00 P. M.	......	[illegible]	34.0	35.0	33.5	35.0	32.8	......	......	SE. 1.	Overcast.	
	2 00	......	24.918	33.3	34.8	33.6	35.0	32.5	......	......	SE. 1.	Overcast.	
	3 00	......	24.906	34.0	34.0	33.0	33.0	31.0	......	......	......	Overcast.	Snowing.
	5 00	......	24.858	34.8	35.0	34.0	30.8	30.5	......	......	......	Overcast.	Snowing.
	7 00	......	24.828	30.7	33.2	32.3	30.7	30.5	......	......	......	Overcast.	Snowing.
Oct. 18,	7 00 A. M.	......	24.784	36.0	35.0	33.5	34.5	31.5	......	......	......	Overcast.	Rain during night.
	9 00	......	24.878	38.3	38.7	38.0	39.3	39.0	......	......	......	Overcast.	Rain during night.
	11 00	......	24.948	40.0	40.5	39.0	41.0	39.5	......	1.30	......	Overcast.	Rain during night.
	1 00 P. M.	......	24.984	42.0	42.5	40.5	42.0	40.5	......	......	SW. 3.	Overcast.	
	2 10	......	25.012	40.0	40.0	38.8	41.0	39.8	......	......	......	Overcast.	
	3 00	......	25.014	39.3	39.8	39.0	40.8	39.7	......	......	......	Overcast.	
	5 00	......	25.052	38.5	39.0	37.8	37.0	36.0	......	......	......	Overcast.	Raining.
	7 45	......	25.034	36.5	36.3	35.9	36.2	35.5	......	......	......	Overcast.	Raining.
	9 00	......	25.047	37.3	37.7	38.5	37.0	36.3	......	......	......	Overcast.	Raining.
Oct. 19,	7 00 A. M.	......	25.094	39.3	38.7	38.0	40.3	39.5	......	......	......	Overcast.	Raining.
	9 00	......	25.077	43.5	43.0	41.8	43.0	42.3	......	0.79	......	Overcast.	Raining.
	11 05	......	25.094	43.0	43.5	42.5	44.0	43.3	39.2	......	......	Overcast.	
	1 00 P. M.	......	25.064	45.8	46.0	44.8	45.5	45.0	......	......	......	Overcast.	Raining.
	2 00	......	25.078	44.2	45.2	44.5	45.5	43.0	......	......	......	Overcast.	Raining.
	3 11	......	25.078	43.5	44.0	43.0	43.8	42.8	......	0.05	......	Overcast.	Raining.
	5 10	......	25.038	43.6	45.0	44.0	41.5	41.0	......	......	......	Overcast.	Raining.
	7 04	......	25.032	40.2	42.0	41.0	41.0	40.2	......	......	......	Overcast.	Raining.
	8 43	......	24.988	40.0	42.0	40.5	39.0	38.3	......	0.06	Calm.	Overcast.	Raining.
Oct. 20,	6 30 A. M.	......	24.833	40.0	40.5	39.5	39.5	39.0	......	......	SW. 3.	Overcast.	Thunder; rain.
	9 00	......	24.826	43.0	42.8	41.8	43.0	42.0	......	......	SW. 3.	Overcast.	Rain.
	11 00	......	24.852	42.8	44.0	43.5	42.3	41.5	......	......	SW. 3.	Overcast.	Rain.
	1 00 P. M.	......	24.856	40.5	41.0	40.8	39.0	38.5	......	......	SW. 3.	Overcast.	Rain.
	2 00	......	24.866	40.0	41.0	40.5	40.3	39.4	......	......	SW. 3.	Overcast.	Rain.
	3 00	......	24.894	40.0	41.3	39.8	39.0	38.5	......	0.44	SW. 3.	Overcast.	Rain.
	5 00	......	24.900	39.0	40.0	39.5	37.8	37.0	......	......	SW. 3.	Overcast.	Clearing up.
	7 00	......	24.900	37.8	38.3	38.0	37.5	36.8	......	......	......	Overcast.	Rain.
Oct. 21,	7 00 A. M.	......	24.964	39.0	38.5	37.8	37.8	37.0	......	......	......	Overcast.	Rain.
	9 05	......	24.976	39.5	40.0	39.5	38.3	37.8	......	......	......	Overcast.	Rain.
	11 00	......	25.006	40.0	40.0	39.3	39.3	38.8	......	......	......	Overcast.	Rain.
	1 00 P. M.	24.832	25.047	40.7	41.0	40.3	42.0	41.3	......	......	SW. 2.	Overcast.	Rain.
	3 00	......	25.052	40.8	41.3	41.0	40.5	39.8	......	......	......	Overcast.	Rain.
	5 00	......	25.058	41.3	41.3	40.5	40.2	39.5	......	0.96	......	Overcast.	Rain.
	8 00	......	25.051	41.0	40.7	40.0	39.7	39.0	......	......	......	Overcast.	
Oct. 22,	6 45 A. M.	......	25.107	37.3	37.4	37.0	36.4	35.5	......	0.02	......	Fog.	Rainy.
	9 00	......	25.096	40.5	40.8	39.8	42.0	41.3	......	......	......	Fog.	
	11 05	......	25.088	46.4	46.0	44.8	51.0	49.0	......	......	Calm.	......	Clearing up.
	0 25 P. M.	......	25.113	52.3	53.0	50.7	88.0	78.0	......	......	......	......	
	1 40	......	25.078	50.0	50.5	48.3	67.5	60.0	......	......	Calm.	Cum. 0.1.	
	2 00	......	25.088	50.5	52.3	50.2	72.0	70.0	......	......	......	......	
	3 05	......	25.094	49.0	50.3	48.5	61.7	54.7	......	......	SW. 2.	Cum. 0.2.	
	5 00	......	25.085	43.3	45.0	43.7	42.3	41.4	......	......	Calm.	Clear.	
	7 00	......	25.036	41.0	42.7	42.0	39.8	39.0	......	......	Calm.	Overcast 0.5.	
	8 00	......	25.000	41.6	42.7	42.0	40.5	39.5	......	......	Calm.	Overcast 0.5.	
Oct. 23,	7 05 A. M.	......	25.025	35.0	35.0	34.5	34.8	33.8	......	0.01	......	Fog.	Dew.
	9 00	24.824	25.032	39.5	39.5	38.5	41.5	40.7	......	......	SW. 1.	Overcast 0.5.	
	11 00	24.810	25.018	44.8	43.8	42.5	55.5	47.5	......	......	......	Overcast 0.7.	
	Noon.	24.809	25.032	48.8	49.8	47.4	80.0	71.8	......	......	......	Overcast 0.7.	
	1 00 P. M.	24.800	25.032	50.0	51.5	48.8	56.5	53.4	......	......	......	Overcast 0.8.	

Meteorological observations—Continued.

SOHON'S PASS.

Date.		Aneroid.	Barometer.	Attached.	Detached.	Wet.	Black.	Naked.	Spring.	Rain.	Wind.	Clouds.	Remarks.
1859.	h. m.			°	°	°	°	°	°	°			
Oct. 23,	2 00 P. M.	......	25 040	50.0	51.0	48.5	66.5	56.0	......	......	......	Overcast 0.6.	
	3 00	......	25.036	48.8	49.5	40.0	54.0	50.0	......	......	......	......	
	4 00	......	25.038	46.6	47.0	45.8	48.0	46.0	......	......	......	......	
	6 00	24.806	25.026	42.0	43 0	42.0	39.5	38.5	......	......	Calm.	Clear.	
	8 00	24 805	25.030	38 0	39.5	39.0	36.3	35.5	......	......	Calm.	Clear.	
Oct. 24,	0 30 A. M.	24.836	25.042	35.3	36.7	36.0	33 8	33.0	......	......	Calm.	Clear.	
	7 00	24.824	25.085	31.8	32.5	32.0	31.0	30 0	......	......	......	Clear.	
	9 00	24.835	25.078	37.8	36.2	35.5	39.8	38.5	......	......	Calm.	Clear.	
	11 00	24.850	25.068	47.0	44.6	42.8	52 0	49 8	......	......	SE. 3.	Cum. 0.6.	
	1 00 P. M.	24.850	25.102	52.4	52.0	47.0	58.2	55.0	......	......	SW. 3.	Cum. 0.6.	
	2 00	24.855	25.102	53.0	55.3	49.7	63.4	61.0	......	......	SW. 1.	Clear.	Beautiful.
	3 00	24.850	25.098	49.5	50.0	46.8	55.2	49.0	......	......	SW. 1.	Cum. 0.4.	
	5 12	24.853	25.078	44.0	44.0	42.0	41.7	41.0	......	......	Calm.	Clear.	
	7 05	24.850	25.092	42.5	43.7	41.8	41.0	40.2	......	......	NE 1.	Clear.	
	9 00	24.850	25.098	44.0	43.5	41 8	42.5	42.0	......	......	......	Overcast.	
Oct. 25,	7 00 A. M.	24.903	25.155	43 3	43.5	42.5	43.3	42.5	......	0.03	W.SW. 4.	Overcast 0.8.	Rain.
	9 13	......	25.202	48.0	46.2	44.5	52.0	50 5	......	......	W.SW. 3.	Overcast 0.8.	
	10 00	......	25.202	48.8	48.0	46.0	51.0	49.2	......	......	W.SW. 3.	Overcast 0.8.	
	11 00	......	25.200	47.2	47.0	45 0	40.9	46.7	......	......	W.SW. 1.	Overcast 0.8.	
	12 03 P. M.	......	25.200	48.8	48.2	46.0	52.8	49.0	......	......	W.SW. 2.	Overcast 0.8.	
	1 08	......	25 202	49.0	48 8	46.5	52.5	49.0	......	......	W.SW. 2.	Overcast 0.8.	
	2 00	......	25.252	50.0	50.0	47.0	53.0	50.2	......	......	W.SW. 2.	Overcast 0.8.	
	3 00	......	25 232	48.0	48.0	46.0	48.0	47.0	......	......	W.SW. 2.	Overcast 0.8.	
	4 06	......	25.240	47.0	47.0	45.8	46.8	45.8	......	......	W.SW. 2.	Overcast 0.8.	
	5 08	25 070	25.214	44.5	45.0	44.0	42.5	41.8	......	......	W.SW. 2.	......	
	7 04	25.060	25.264	42.0	42 5	41.4	38.5	38.0	......	......	Calm.	Clear.	
Oct. 26,	1 07 A. M.	25.085	25.296	35.3	37.0	36 0	32.5	31.5	......	......	Calm.	Clear.	
	2 30	25 084	25 304	34.8	35.5	35.0	31.8	30.8	......	......	Calm.	Clear.	
	7 45	25.090	25.314	33.5	33.7	33.0	32.0	31.5	......	......	Calm.	Clear.	
	9 00	25.095	25.312	35 2	36.5	34.8	37.5	36.5	......	......	Calm.	Clear.	
	11 00	25.096	25.316	43 0	41.5	40.3	50.4	47.5	......	......	S.SE. 2.	Clear.	
	Noon.	25.074	25.300	49.8	51.7	50 8	96.0	83.8	......	......	*	Clear.	
	3 00 P. M.	25.040	25.284	47.5	47.5	46.0	52.0	48.0	......	......	......	Clear.	
	11 20	24.985	25.186	39.5	33.0	39.5	......	......	......	......	Windy 2.	Clear.	Max. of black bulb 96°.
Oct. 27,	6 30 A. M.	24.857	......	30.5	......	......	30.5	29.5	......	......	......	......	No snow among the timber until 1,000 feet above the pass. At

	8 00	24.850	25.199	30.7	31.5	......	30.3	29.3	......	......	Calm.	Clear.	Stevens's peak, 9,000 feet higher, only a few snow patches near bushes, and in the ravine to the NE. of it an eternal snow wall of about 100 feet in height. Two lakes at the bottom further on.
	10 00	....	25.096	37.0	36.0	35.4	37.0	35.0	......	......	Calm.	Clear.	
	11 00	24.840	25.096	40.5	39.0	37.8	59.5	45.4	......	......	Calm.	Clear.	
	Noon.	24.842	25.100	47.3	49.3	45.3	64.5	49.5	......	......	S. 2.	Clear.	
	1 00 P. M.	....	25.096	47 8	47.0	44.0	50.2	48 0	......	......	S. 2.	Clear.	
	4 10	....	25.088	42.0	42 3	40.7	41.5	40.5	......	......	Calm.	Clear.	
	7 30	....	25.034	38.5	39.0	37.5	37.3	36.0	......	......	Calm.	Clear.	
	10 15	....	25.040	40.0	40 5	39.5	39.8	38.8	......	......	Calm.	Clear.	
Oct. 28,	7 00 A. M.	....	25.112	37.4	37.3	36.3	36.7	35.7	......	......	Calm.	Overcast.	
	9 00	....	25.152	42.0	42.5	41.0	43.5	42.0	......	......	Calm.	Overcast.	
	11 15	....	25.187	45.5	45.0	43.0	46.0	44.0	......	......	Calm.	Overcast.	
	1 00 P. M.	....	25.188	44.0	44.5	42.5	44.0	42.5	......	......	Calm.	Overcast.	
	2 00	....	25.168	45.2	45.0	43.0	44.8	43.0	......	......	Calm.	Overcast.	
	3 00	....	25.168	45.5	45.0	43 0	44.0	43.4	......	......	Calm.	Overcast.	
	5 00	....	25.178	41.8	43 0	41.8	40.6	40.5	......	......	Calm.	Overcast.	
	9 20	....	25.222	39.0	40.2	39.2	37.5	37.3	......	......	Calm.	Overcast.	
Oct. 29,	4 15 A. M.	....	25.240	34.0	35.8	35 0	32.5	31.3	......	......	Calm.	Clear.	
	6 55	....	25.254	32.8	33.8	33.2	31.8	30.8	......	......	Calm.	Clear.	
	9 00	....	25.314	38.0	39.0	37.5	38.4	36.8	......	......	Calm.	Clear.	
	10 30	....	25.332	44 0	44.8	42.0	55.5	46.8	......	......	Calm.	Clear.	Beautiful blue sky.
	1 00 P. M.	....	25.332	48.0	49.2	46.0	59.0	52.3	......	......	Calm.	Clear.	
	3 20	....	25.339	43.0	45.0	42.5	41.3	40.5	......	......	Calm.	Clear.	
	8 00	....	25.364	38.0	39.6	39.0	36 5	36.8	......	......	Calm.	Clear.	
	10 00	....	25.348	38.5	38.8	38.0	36 5	37.0	......	......	Calm.	Clear.	
Oct. 30,	Midnight.	....	25.342	38.0	37.5	36 5	34.8	34.0	......	......	Calm.	Clear.	Bar. max.
	2 15 A. M.	....	25.374	36.0	37.0	35.0	35.5	35.0	......	......	Calm.	Clear.	
	8 05	....	25.386	36 0	36 0	35.0	34.0	33.0	......	......	Calm.	Clear.	Beautiful blue sky. Observed stars during the day.
	10 15	....	25.384	48.0	48.0	44.5	46.0	44.5	......	......	Calm.	Clear.	
	Noon.	....	25.364	51.4	65.3	58.5	82 8	66.0	......	......	Calm.	Clear.	
	1 45 P. M.	....	25.340	53.0	61.3	55.5	52 5	52.0	......	......	Calm.	Clear.	
	4 35	....	25.360	45.0	47.0	43.5	43.4	42.5	......	......	Calm.	Clear.	
	7 50	....	25.296	38.5	40.8	39.0	37.0	36.0	......	......	Calm.	Clear.	
Oct. 31,	6 30 A. M.	....	25.292	33.0	34.0	33.0	34.0	33.0	......	......	Calm.	Clear.	
	9 00	....	25.264	39 5	39.8	37.8	40.0	38.0	......	......	Calm.	Overcast.	
	11 00	....	25.280	46.2	46.0	44.0	68.5	55.5	......	......	Calm.	Overcast 0.7.	
	0 05 P. M.	....	25.266	50 5	53.5	50.5	54.5	49.5	......	......	Calm.	Overcast.	
	2 00	....	25.274	48 5	50 5	46.5	48.8	46.8	......	......	Calm.	Overcast.	
	4 20	....	25.258	44.5	44.6	42.5	......	......	......	......	Calm.	Overcast.	
	7 25	....	25.218	35.2	......	......	......	......	......	......	Calm.	Clear.	

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* Wind turning around the horizon within 15 minutes, for many hours.

Meteorological observations—Continued.

SOHON'S PASS.

Date.	Station or camp.	Aneroid.	Barometer.	Attached.	Detached.	Rain.	Wind.	Clouds.	Remarks.
1859. h. m.				°	°				
Nov. 1, 7 00 A. M.	Sohon's pass	....	25.128	32.0	......	......	....	Variable.	Moved down the Regia Borgia for about 30 miles, and crossed over a low divide to the Bitter Root.
7 35	.... do	....	25.120	32.3	......	......	....	....	
0 05 P. M.	Station 5.4 miles from pass.	26.027	26.259	49.0	......	......	....	....	
7 00	Camp 12 miles from pass...	....	26.464	39.5	38.5	......	Calm.	Overcast.	
8 10	........do..........do	....	26.424	39.5	40.8	......	....	....	
Nov. 2, 7 00 A. M.	....	....	26.322	37.0	38.0	......	....	....	
8 10	....	....	26.327	39.5	40.0	0.10	Calm.	Overcast.	Raining all day.
7 10 P. M.	Regia Borgia last crossing..	....	26.652	41.5	40.0	0.07	....	....	Snowing during the night.
Nov. 3, 8 50 A. M.	.... do..........do	....	26.564	35.5	33.8	......	....	....	On the divide 8 in. snow.
Nov. 4, 11 10 P. M.	Bitter Root observatory	....	27 296	22.0	22.0	......	Calm.	Clear.	66 feet above water.

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
					Dry.	Wet.	Dry.	Wet.							
1859. h. m.			°	°		°	°	°	°	°	°				
Nov. 5, 8 00 A. M.	......	27.248	21.5	22.0	......	......	......	......	......	......	......	......	......	......	
10 00	......	27.230	29.0	30.8	......	......	......	......	......	......	......	......	......	......	
1 15 P. M.	......	27.240	37.0	38.8	......	36.0	......	......	41.2	38.0	......	......	......	......	
3 05	......	27.216	37.5	39.0	......	36.3	39.4	35.5	38.7	37.4	39.4	......	W.SW. 0.2	Stra. 1.0.	
5 00	......	27.206	34.8	35.5	......	34.0	......	......	33.8	32.8	......	......	......	......	
7 10	......	27.174	31.5	33.3	......	32.0	......	......	30.5	29.0	......	......	......	......	
8 30	......	27.156	31.5	33.3	......	32.0	......	......	30.0	29.0	......	......	W.SW. 0.2	Overcast.	Snowing.
Nov. 6, 8 04 A. M.	......	27.113	28.5	29.0	......	28.5	......	......	29.5	27.5	......	......	SW. 2.	Cum. stra. 0.3.	
9 18	......	27.118	31.8	32.8	......	31.0	......	......	33.0	30.5	......	......	SW. 2.	Cum. stra. 0.3.	
11 00	......	27.100	37.8	39.5	......	37.0	......	......	44.5	38.8	......	......	SW. 2.	Cum. stra. 0.3	
1 00 P. M.	......	27.090	42.0	43.0	......	39.8	......	......	51.8	43.5	......	......	SW. 2.	Cum. stra. 0.3.	Snowing.
2 10	......	27.104	40.5	41.3	......	38.2	......	......	40.0	38.0	......	......	SW. 2.	Cum. stra. 0 3.	
3 00	......	57.136	46.0	46.0	......	42.0	......	......	41.3	38.8	......	......	SW. 2.	Cum. stra. 0.3.	
5 33	......	27.082	33.0	33.5	......	32.8	......	......	29.0	27.5	......	......	SW. 2.	Cum. stra. 0.3.	
7 28	......	27.036	27.5	28.5	......	28.0	......	......	24.5	24.5	......	......	N. 1.	Clear.	
10 30	......	27.076	25.0	27.5	......	......	......	......	22.5	21.5	......	......	W. 2.	Overcast 0.8.	
Nov. 7, 7 35 A. M.	......	27.082	25.0	26.2	......	......	......	......	24.5	22.7	......	......	W. 2.	Overcast 0.4.	Snowing.
9 18	......	27.150	33.0	34.3	......	31.5	......	......	55.0	40.0	......	......	W. 2.	Overcast 0.4.	Snowing.
11 00	......	27.154	35.5	36.8	......	34.8	......	......	49.0	38.0	......	......	W. 2.	Overcast 0.4.	Snowing.
1 00 P. M.	......	27.187	33.7	34.0	......	33.0	......	......	31.5	29.5	......	......	Calm.	......	Snowing.
2 00	......	27 174	34.5	34.5	......	33.5	......	......	37.8	32.8	......	......	......	......	Snowing.
3 05	......	27.172	34.5	34.5	......	33.8	......	......	32.5	30.8	......	......	Calm.	......	Snowing.
5 00	......	27.196	31.0	30.8	......	30.0	......	......	28.0	27.0	......	......	......	Clear.	
8 22	......	27.210	28.8	29.0	......	28.0	......	......	25.5	24.5	......	......	W.SW. 0.2	......	Snowing, 1.5 in.
10 45	......	27.242	26.3	28.6	......	28.0	......	......	24.0	22.5	......	0.11	......	......	Snowing.
Nov. 8, 7 35 A. M.	......	27.236	18.2	19.5	......	......	......	......	17.0	15.5	......	......	W. 2.	Overcast 0.6.	
9 13	......	27.200	25.0	26.8	......	26.0	......	......	38.4	28.0	......	......	W. 2.	Overcast 0.3.	
11 00	......	27.198	30.5	33.0	......	30.8	......	......	33.0	28.5	......	......	W. 2.	Overcast 0.6.	
2 00 P. M.	......	27.080	38.4	38.8	......	37.5	......	......	38.4	31.5	......	......	W. 2.	Overcast 0.6.	
3 00	......	27.024	37.0	37.0	......	36.0	......	......	33.0	31.0	......	......	W. 2.	Overcast 1.0.	
5 00	......	26.942	32.5	32.5	......	32.0	......	......	30.0	28.8	......	......	W. 2.	Overcast.	
7 32	......	26.823	33.0	33.8	......	33.0	......	......	......	33.5	......	......	......	Overcast.	Snowing.
10 20	......	26.967	29.5	30.3	......	29.7	......	......	27.0	25.8	......	......	W. 5.	Overcast.	Snowing.
11 30	......	26.972	27.5	30.0	......	......	......	......	25.5	24.5	......	0.13	W. 2.	Overcast.	Snowing; 1.4 inch.
Nov. 9, 7 10 A. M.	......	27.067	15.5	17.0	......	......	......	......	12.7	11.0	......	......	W. 1.	Overcast 0.3.	

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
					Dry.	Wet.	Dry.	Wet.							
1859. h. m.			°	°		°			°	°	°				
Nov. 9, 9 00 A. M.	......	27.086	22.5	23.4	......	......	......	......	41.0	25 0	......	......	W. 1.	Overcast 0.3.	
11 00	......	27.134	30.0	31.3	......	......	......	......	31.8	26.8	......	......	W. 1.	Overcast 0 3.	
1 00 P. M.	......	27.130	32.8	33.3	......	31.5	......	......	37.8	30.0	......	......	W. 3.	Overcast 0.7.	
3 08	......	27.118	29.4	29.8	......	28.8	......	......	28.0	25.3	......	......	W. 3.	Overcast 0.7.	
7 00	......	27.070	17.5	19.5	......	......	......	......	10.5	8.8	......	......	W. 1.	Clear.	
10 10	......	27.034	11.0	16.3	......	......	......	......	3.5	+ 2.0	......	......	Calm.	Clear.	
Nov. 10, 1 10 A. M.	......	26.988	4.0	7.7	......	......	......	......	+ 0.5	− 0.5	......	......	W.SW. 1.	Cum. 0.1.	
7 20	......	26.977	7.0	9.0	......	......	......	......	+ 3.5	+ 2.0	......	......	W. 1.	Cum. 0.8.	
9 15	......	26.978	11.0	13.5	......	......	......	......	11.0	7.8	33.0	......	W. 1.	Cum. 1.0.	Drift ice in the river.
11 00	......	26.950	20.0	21.0	......	......	......	......	18.5	15.4	......	......	W. 2.	Cum. 1.0.	
1 00 P. M.	......	26.974	24.0	24.0	......	......	......	......	20.0	17.0	......	......	W. 2.	Cum. 1.0.	
2 00	......	26.975	22.0	23.5	......	......	......	......	19.5	16.5	......	......	W. 2.	Cum. 0.9.	
4 00	......	26.997	18.5	19.5	......	......	......	......	15.5	14.5	......	......	NW. 2.	Cum. 1.0.	
7 00	......	27.098	11.0	17.7	......	......	......	......	12.0	11.0	......	......	NE. 3.	Cum. 1.0.	
*11 00	......	27.192	12.7	14.0	......	......	......	......	9.5	8.5	......	......	N. 2.	Cum. 1.0.	
Nov. 11, 1 00 A. M.	......	27.206	11.0	14.5	......	......	......	......	8.2	9.0	......	......	N. 2.	Cum. 1.0.	
7 00	......	27.318	7.0	09.5	......	......	......	......	4.0	2.7	......	......	NW. 1.	Cum 1.0.	
9 05	......	27.472	10.0	11.0	......	......	......	......	24.5	11.0	32.5	......	NW. 1.	Cum. 0.2.	Drift ice.
11 00	......	27.522	13.7	17 0	......	......	......	......	29.2	14.3	......	......	E. 3.	Cum. 0 2.	
0 50 P. M.	......	27.568	14.0	15.0	......	......	......	......	29.5	14.5	......	......	NE. 2.	Cum. 0.2.	
2 00	......	27.584	12.5	12.0	......	......	......	......	27.5	14.0	......	......	NE. 2.	Cum. 0.2.	
3 00	......	27.629	14.5	15.2	......	......	......	......	12.3	10.0	......	......	NW. 1.	Cum. 0.2.	
5 20	......	27.658	6 0	8.5	......	......	......	......	+ 4 0	+ 2.8	......	......	NW. 1.	Clear.	
7 20	......	27.722	+0.8	+2.7	......	......	......	......	− 4.0	− 5.5	......	......	NW. 1.	Clear.	
10 05	......	27.776	−3.5	−0.5	......	......	......	......	− 7.5	− 9.0	......	......	Calm.	Clear.	
Nov. 12, 1 55 A. M.	......	......	−4.5	−1.5	......	......	......	......	......	......	......	......	......	......	
2 10	......	27.824	−3.0	−1.0	......	......	......	......	−10.0	−10.5	......	......	Calm.	Clear.	Drift ice.
7 25	......	27.849	−5.0	−3.0	......	......	......	......	−12.0	−10.5	32.8	......	NW. 1.	Clear.	River froze 1-10 of its breadth; ice 2¼ inches thick near shore.
9 05	......	27.880	+0.5	+3.5	......	......	......	......	+11.3	+ 0 5	......	......	SE. 1.	Clear.	
10 00	......	27.848	4.0	6.0	......	......	......	......	21.0	7.0	......	......	SE. 1.	Clear.	
11 00	......	27 850	10.5	19.3	......	......	......	......	27.8	12.5	......	......	NW. 1.	Cirrus 0.6.	
Noon.	......	27.833	13 0	20.0	......	......	......	......	29.7	15.0	......	......	E. 1.	Clear.	
1 15 P. M.	......	27.778	18.0	19.0	......	......	......	......	31.8	17.0	......	......	E. 1.	Clear.	
2 00	......	27.792	19.0	20.0	......	......	......	......	32.8	19.0	......	......	E. 1.	Clear.	

	3 05	......	27.790	22.8	22.5	......	......	......	......	18.5	14.8	......	......	E. 1.	Clear.	
	5 00	......	27.758	10.5	11.0	......	......	......	......	6.5	5.0	......	......	W. 1.	Clear.	
	6 30	......	27.739	5.7	8.0	......	......	......	......	+ 2.3	+ 0.5	......	......	Calm.	Clear.	
	8 00	......	27.742	3.5	5.7	......	......	......	......	− 0.3	− 1.5	......	......	Calm.	Clear 0 1.	
Nov. 13,	0 40 A. M.	......	27.733	1.0	3.2	......	......	......	......	− 0.5	− 1.8	......	......	E. 1.	Clear 0.4.	Drift ice. Moon's halo
	3 00	......	27.664	6.5	9.5	......	......	......	......	+ 1.5	+ 0.3	......	......	W.NW. 2.	Clear 0.5.	
	9 00	......	27.552	15.0	15.0	......	......	......	......	11.5	9.8	......	......	......	Overcast.	Snowing.
	11 00	......	27.532	17.5	17.8	......	......	......	......	13.5	11.8	......	......	......	Clear.	
	1 00 P. M.	......	27.468	21.0	22.0	......	......	......	......	16.5	15.0	......	......	Calm.	Overcast.	Snowing.
	3 15	......	27.396	22.0	22.2	......	......	......	......	19.8	18.0	......	......	Calm.	Overcast.	Snowing.
	5 00	......	27.412	21.8	22.0	......	......	......	......	19.5	18.5	......	0.27	Calm.	Overcast.	Snowing; 3 inches.
	6 30	......	27.414	21.7	23.0	......	......	......	......	20.5	19.5	......	......	Calm.	......	Clearing up.
Nov. 14,	1 30 A. M.	......	27.390	24.7	25.5	......	......	......	......	24.3	22.7	......	......	W. 2.	Overcast 0.7.	
	3 00	......	27.342	26.0	26.5	......	......	......	......	24.5	23.8	......	......	W 2.	Overcast 1.0.	
	5 00	......	27.355	25.7	27.3	......	......	......	......	24.3	23.2	......	......	W. 3.	Overcast 1.0.	Drift ice.
	7 30	......	27.330	26.0	27.7	......	......	......	......	25.8	25.0	......	......	W. 2.	Overcast 1.0.	Rainy.
	9 00	......	27.342	30.8	31.0	......	......	......	......	29.0	27.5	......	......	......	......	Rainy.
	11 00	......	27.302	34.0	34.4	......	......	......	......	34.5	32.0	......	......	......	......	Rainy.
	1 00 P. M.	......	27.276	37.8	38.0	......	......	......	......	38.0	35.0	......	0.15	SW. 2.	......	Rainy.
	3 15	......	27.228	34.8	36.0	......	35.0	......	......	35.5	34.0	......	......	Calm.	......	Rainy.
	5 05	......	27.180	34.0	34.8	......	33.5	......	......	34.0	33.0	......	......	Calm.	......	Rainy.
	8 00	......	27.181	35.0	35.5	......	34.5	......	......	33.5	32.5	......	......	Calm.	......	Rainy.
Nov. 15,	8 00 A. M.	......	27.036	32.4	32.5	......	32.0	......	......	32.8	31.8	......	......	Calm.	Overcast.	Rainy.
	9 10	......	27.032	33.0	34.0	......	32.3	......	......	35.0	33.0	......	......	Calm.	Overcast.	Rainy.
	11 00	......	27.038	37.5	38.5	......	36.7	......	......	37.8	35.8	......	0.45	Calm.	Overcast.	Rainy.
	1 00 P. M.	......	27.050	40.5	43.0	......	41.5	......	......	43.2	40.3	......	......	W. 2.	Overcast.	Rainy.
	3 00	......	27.092	40.3	40.5	......	39.5	......	......	41.0	39.5	......	......	W.NW. 2.	Cirrus 0.9.	
	5 00	......	27.088	35.3	35.8	......	35.2	......	......	35.8	34.8	......	......	W.NW. 2.	Cirrus 0.7.	
	7 00	......	27.179	34.0	35.0	......	34.0	......	......	33.3	32.3	......	......	W.NW. 2.	Cirrus 0.6.	
Nov. 16,	3 45 A. M.	......	27.280	32.5	32.3	......	32.0	......	......	32.5	32.0	......	......	W.NW. 2.	Overcast.	Rainy.
	7 40	......	27.342	32.0	32.0	......	31.5	......	......	32.0	31.0	......	......	W. 1.	Overcast.	
	9 02	......	27.338	32.8	33.0	......	32.5	......	......	33.5	32.0	......	0.11	W. 1.	Overcast.	Snowing.
	11 00	......	27.344	38.5	39.8	......	38.4	......	......	42.0	38.0	......	......	Calm.	Overcast 0.5.	
	1 00 P. M.	......	27.384	41.3	43.0	......	41.5	......	......	46.5	41.0	......	......	W. 1.	Overcast 1.0.	
	2 00	......	27.383	39.7	41.0	......	39.5	......	......	43.0	40.5	......	......	W. 2.	Overcast 0.9.	
	3 00	......	27.376	39.8	40.0	......	38.5	......	......	41.5	39.0	......	......	NW. 1.	Overcast 0.9.	
	5 00	......	27.350	34.8	34.8	......	......	......	......	35.0	34.5	......	......	W. 2.	Overcast 1 0.	
	7 00	......	27.369	35.0	35.5	......	34.5	......	......	33.7	32.5	......	......	W. 1.	Overcast 1.0.	
Nov. 17,	7 30 A. M.	......	27.202	31.2	31.3	......	31.0	......	......	31.5	30.8	......	......	Calm.	Overcast 1.0.	
	9 00	......	27.184	32.0	32.5	......	32.0	......	......	33.0	31.8	......	......	Calm.	Overcast 1.0.	
	11 00	......	27.124	36.5	37.0	......	35.8	......	......	36.5	34.6	......	......	S. 1.	Overcast 1 0.	
	1 00 P. M.	......	27.068	36.8	38.0	......	37.0	......	......	37.4	35.8	......	......	S. 1.	Overcast 1.0.	
	2 00	......	27.040	36.5	37.5	......	36.7	......	......	38.0	36.2	......	......	S. 1.	Overcast 1.0.	Rainy.
	3 13	......	26.970	36.0	36.0	......	35.5	......	......	35.8	34.5	......	......	S. 1.	Overcast 1.0.	Rainy.
	5 05	......	26.992	34.8	34.0	......	33.5	......	......	34.4	33.2	......	......	S. 1.	Overcast 1.0.	Rainy.
	7 00	......	26.986	34.5	35.5	......	34.5	......	......	33.5	32.5	......	0.28	S. 1.	Overcast 1.0.	Rainy.
Nov. 18,	7 45 A. M.	......	26.960	33.5	32.3	......	31.9	......	......	32.5	31.8	......	......	W. 1.	Overcast 1.0.	Rainy.
	9 45	......	27.005	33.7	34.3	......	33.5	......	......	35.0	34.5	......	......	SW. 1.	Overcast 1.0.	Rainy.
	Noon.	......	27.000	40.8	42.5	......	41.2	......	......	42.5	38.8	......	......	Calm.	Overcast 1.0.	Rainy.
	2 00 P. M.	......	27.053	42.5	44.0	......	42.5	......	......	42.0	40.5	......	......	SW. 1.	Overcast 1.0.	Rainy.
	4 00	......	27.064	40.0	39.5	......	38.7	......	......	38.5	37.5	......	......	Calm.	Overcast 1.0.	Rainy.
	6 00	......	27.122	37.0	36.5	......	36.0	......	......	35.5	34.5	......	......	Calm.	Overcast 1.0.	Rainy.
	7 50	......	27.144	42.5	39.0	......	37.8	......	......	34.5	33.5	......	0.40	Calm.	Overcast 1.0.	Rainy.

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	N.-ked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1859.	h. m.			°	°		°	°	°	°	°	°	°			
Nov. 19,	6 45 A. M.	....	27.134	31.5	33.5	......	32.7	......	......	32.0	31.3	......	......	Calm.	Overcast.	Rainy.
	9 10	....	27.132	34.8	34.3	......	33.6	......	......	32.8	31.8	......	......	Calm.	Overcast.	Rainy.
	11 05	....	27.106	38.2	38.0	......	37.2	......	......	35.0	33.6	......	......	Calm.	Overcast.	Snowing.
	1 15 P. M.	....	27.108	40.8	41.0	......	39.8	......	......	37.0	35.4	......	......	Calm.	Overcast.	Rainy.
	3 17	....	27.112	40.0	40.0	......	39.0	......	......	37.0	35.8	......	......	Calm.	Overcast.	Rainy.
	5 05	....	27.124	38.5	38.5	......	36.0	......	......	34.0	33.0	......	......	Calm.	Overcast.	Foggy.
	8 10	....	27.172	36.5	35.5	......	34.5	......	......	32.0	30.8	......	......	Calm.	Overcast.	Snowing.
Nov. 20,	8 15	....	27.018	31.0	31.8	......	33.0	......	......	33.0	32.0	......	......	Calm.	Overcast.	Snowing.
	9 20	....	27.014	34.5	34.0	......	33.5	......	......	35.0	31.0	......	......	Calm.	Overcast.	Snowing.
	11 35	....	27.006	44.5	43.8	......	42.8	......	......	39.0	37.0	......	......	Calm.	Overcast.	Raining.
	0 30 P. M.	....	26.960	47.5	48.0	......	46.5	......	......	42.0	39.3	......	......	Calm.	Overcast.	Raining.
	2 15	....	26.960	43.6	43.4	......	42.5	......	......	36.8	35.2	......	0.14	Calm.	Overcast.	Raining.
	3 40	....	26.984	41.2	41.0	......	40.5	......	......	37.2	35.8	......	......	NW. 1.	Overcast.	
	4 45	....	26.908	34.5	35.0	......	34.5	......	......	33.8	32.8	......	......	....	Overcast.	Raining.
	7 10	....	26.916	39.0	38.0	......	37.0	......	......	33.4	32.0	......	......	....	Overcast.	Raining. Aneroid, at 8 p. m, 26.800.
	8 45	....	26.890	37.0	35.0	......	34.5	......	......	33.0	31.5	......	0.14	....	Overcast.	Raining.
Nov. 21,	8 00	....	26.914	33.0	32.5	......	31.5	......	......	31.0	30.0	......	......	....	Overcast.	
	10 30	26.770	26.963	38.7	38.3	......	37.0	......	......	38.5	35.3	......	......	....	Overcast 0.7.	
	Noon.	26.763	26.966	43.0	46.7	......	44.0	......	......	54.2	42.2	......	......	SW. 1.	Overcast 0.3.	
	2 00 P. M.	26.765	26.963	39.7	39.5	......	38.0	37.0*	31.8*	35.5	33.5	......	......	S. SW. 1.	Overcast 0.9.	Snowing.
	4 00	26.758	26.966	36.5	36.5	......	36.0	34.3	34.0	34.6	32.5	......	......	SW. 1.	Overcast 1.0.	Snowing.
	6 00	26.793	26.964	36.5	35.0	......	34.0	33.5	33.0	32.0	31.0	......	......	Calm.	Overcast 1.0.	Snowing.
Nov. 22,	8 30 A. M.	26.895	27.115	33.0	32.8	......	32.0	30.5	30.0	31.0	28.8	......	0.04	NW. 2.	Overcast 0.9.	Snowing; ½ inch.
	11 00	26.947	27.135	33.8	33.0	......	32.0	31.0	30.5	30.8	29.3	......	......	N. 2.	Overcast 1.0.	
	2 00	26.975	27.187	34.7	34.2	......	32.4	31.0	30.6	31.2	29.5	......	......	NE. 2.	Overcast 1.0.	
	7 40	27.085	27.292	31.0	31.5	......	29.5	26.0	25.5	25.0	24.0	......	......	E. 2.	Overcast 1.0.	
Nov. 23,	8 30 A. M.	27.180	27.367	16.5	15.5	......	......	12.0	11.5	12.2	10.5	......	......	Calm.	Overcast 0.1.	
	Noon.	27.144	27.348	26.8	30.8	......	......	25.3	25.0	35.0	25.2	......	......	S. 2.	Overcast 1.0.	
	2 00 P. M.	27.122	27.324	27.5	31.0	......	28.5	25.5	25.0	27.5	23.5	......	......	S. 1.	Overcast 1.0.	
	4 10	27.090	27.273	25.3	26.3	......	......	23.2	22.7	22.5	21.3	......	......	E. 1.	Overcast.	*From* ** to **, both dry for comparison.
	6 00	27.055	27.263	27.0	26.7	......	25.5	21.0*	22.3*	22.0	21.0	......	......	NE. 2.	Overcast 1.0.	
Nov. 24,	8 00 A. M.	26.947	27.162	21.8	24.3	......	......	19.0	18.2	18.5	17.0	0.08	......	Calm.	Overcast 1.0.	Snow 1 inch.
	10 00	26.970	27.192	27.8	28.0	......	27.0	23.0	......	21.7	19.0	......	......	NW. 1.	Overcast 1.0.	Drift ice.
	Noon.	26.953	27.132	28.0	27.0	......	25.0	26.0	24.8	26.0	22.3	......	......	Calm.	Overcast 1.0.	
	2 00 P. M.	26.938	27.122	28.5	29.5	......	26.2	27.3	26.2	24.6	24.4	......	......	Calm.	Overcast 1.0.	Snowy.

	4 00	26.949	27.184	27.5	28.2	......	27.5	26.3	24.2	24.0	22.3	......	......	NE. 1.	1.0.	Snowing.
	6 05	26.919	27.140	26.8	26.5	......	26.5	23.0	22.8	22.5	21.2	0.03	......	NE. 1	1.0.	Snowing, 0.4 inch.
Nov. 25,	8 00 A. M.	27.022	27.200	23.2	24.0	......	23.0	18.5	17.5	18.3	16.6	......	......	Calm.	1.0.	Drift ice.
	10 00	27.020	27.213	27.5	27.0	.. ..	26.0	21.3	20.3	22.5	19.7	......	......	W. 1.	1.0.	
	Noon.	27.002	27.197	30.5	31.5	......	31.2	25.5	25.2	26.2	23.0	......	......	E. 1.	1.0.	
	2 00 P. M.	26.967	27.172	33.7	34.3	......	31.8	28.8	26.5	31.3	26.5	......	......	E. 1.	1.0.	
	4 00	26.945	27.148	29.5	30.5	......	......	26.5	25.3	28.6	24.5	......	......	N. 1.	0.6.	
	6 10	26.922	27.097	21.5	22.0	......	22.0	20.3	19.2	19.5	16.5	......	......	Calm.	0.2.	
Nov. 26,	8 00 A. M.	27.058	27.248	25.5	26.0	......	25.5	22.9	21.5	21.7	20.5	......	......	Calm.	1.0.	Drift ice.
	10 00	27.122	27.327	28.2	28.0	....	27.0	25.0	23.3	25.5	23.5	......	......	N.NE. 1.	1.0.	
	Noon.	27.138	27.333	30.0	30.5	......	29.0	26.2	24.5	27.2	24.3	......	......	NE. 1.	1.0.	Snowing.
	2 00 P. M.	27.147	27.340	31.3	31.0	......	29.5	26.2	24.3	27.0	24.3	......	......	N. 1.	1.0.	
	4 00	27.175	27.378	30.7	31.3	......	29.0	25.0	23.5	24.5	23.0	......	......	N. 1.	1.0.	
	6 00	27.203	27.392	27.0	27.2	......	26.0	24.5	22.7	23.3	22.0	......	......	NE. 1.	1.0.	
	8 00	27.222	27.404	27.8	27.5	......	26.2	23.0	22.0	22.0	21.0	......	......	N. 1.	1.0.	
Nov. 27,	8 00 A. M.	27.290	27.496	22.8	23.0	......	22.0	19.2	18.0	18.8	17.5	......	......	NW. 1.	0.9.	Drift ice.
	9 00	27.293	27.496	23.5	25.0	.. ..	24.0	20.0	19.0	21.5	19.0	......	......	NW. 2.	0.9.	Sunrise.
	10 00	27.312	27.513	27.5	27.3	......	26.0	22.3	21.0	27.3	22.2	......	......	SW. 2.	0.8.	
	11 00	27.306	27.508	24.7	27.0	....	23.0	24.2	22.7	34.0	21.2	......	......	S. 2.	0.2.	
	Noon.	27.302	27.502	28.0	28.3	......	30.8	27.8	25.6	48.5	36.4	......	......	S. 1.	Clear.	
	1 00 P. M.	27.287	27.492	26.0	27.5	....	25.5	28.5	20.5	45.8	31.0	......	......	N. 1.	Clear.	
	2 00	27.302	27.498	35.0	31.5	......	27.5	29.5	26.6	29.3	26.3	......	......	S. 1.	Clear.	
	3 00	27.270	27.476	27.5	28.0	......	26.5	29.0	28.0	28.5	26.5	......	......	S. 1.	Clear.	
	4 00	27.260	27.468	23.0	23.3	......	22.3	24.5	23.4	23.0	21.5	......	......	S. 1.	0.3.	
	5 00	27.264	27.460	21.7	21.8	....	21.2	21.0	20.2	20.0	18.5	......	....	Calm.	Clear.	
	6 00	27.255	27.448	18.0	18.3	......	17.5	17.0	16.0	15.0	13.5	......	......	N. 1.	Clear.	
Nov. 28,	7 30 A. M.	27.165	27.348	13.0	14.5	......	14.0	11.0	10.0	10.2	8.5	......	......	Calm.	0.2.	During night calm.
	9 00	27.152	27.337	16.0	17.0	......	16.5	14.5	13.0	18.5	14.0	......	......	W. 1.	0.5.	
	10 00	27.163	27.344	19.2	20.3	. ....	19.0	19.0	17.5	29.0	21.0	......	....	Calm.	0.3.	
	11 00	27.150	27.337	23.0	28.3	....	23.0	22.3	20.3	32.6	22.3	......	......	SE. 1.	0.4.	
	Noon.	27.118	27.326	26.8	29.8	......	27.0	24.3	22.7	27.5	23.0	......	....	S. 1.	0.8.	
	1 00 P. M.	27.105	27.312	26.3	28.2	......	26.2	26.0	24.3	31.5	25.0	......	......	S. 1.	0.7.	
	2 00	27.087	27.287	27.5	28.0	......	25.8	25.8	23.8	28.0	24.3	......	......	NW. 1.	0.9.	
	3 00	27.081	27.283	27.5	28.3	......	26.2	27.2	25.3	28.2	25.5	......	......	N. 1.	1.0.	
	4 00	27.073	27.272	27.5	27.3	....	25.8	27.0	25.3	26.5	25.2	......	......	Calm.	1.0.	
	5 00	27.047	27.259	26.5	25.8	......	24.8	25.0	24.0	24.5	23.3	......	......	N. 1.	0.8.	
	6 00	27.022	27.219	26.7	26.5	......	25.3	25.0	23.7	24.0	22.5	......	......	NW. 1.	0.3.	
	7 15	27.009	27.195	23.5	24.5	......	22.0	21.0	20.0	19.8	18.8	......	......	Calm.	Clear.	
	8 00	27.000	27.196	22.0	23.0	....	22.2	20.2	19.5	19.5	18.0	......	......	W. 1.	0.8.	Clearing up for short intervals.
Nov. 29,	8 00 A. M.	26.903	27.092	28.5	29.0	....	28.0	26.0	25.2	25.5	24.5	......	......	Calm.	1.0.	Snowy.
	10 00	26.917	27.097	30.8	30.0	......	29.0	28.0	27.0	27.8	26.2	......	0.01	SE. 1.	1.0.	Snowy.
	Noon.	26.920	27.102	33.2	33.5	......	31.5	32.3	31.3	34.8	32.0	......	......	NW. 1.	1.0.	
	2 00 P. M.	26.905	27.090	38.2	38.3	......	35.2	38.0	36.0	39.5	37.0	......	....	Calm.	1.0.	
	4 00	26.887	27.087	37.0	37.0	......	35.0	36.5	35.3	36.6	35.8	....	......	W. 1.	1.0.	
	6 00	26.875	27.057	34.5	34.5	......	33.2	34.8	34.2	33.8	32.7	......	......	NE. 1.	1.0.	Raining.
	8 10	26.863	27.042	37.5	36.7	......	35.5	33.5	33.2	32.5	31.3	......	......	Calm.	1.0.	Observatory, 26.870.
	9 01	26.843	27.022	37.3	37.0	. ...	35.5	......	......	......	......	......	0.01	Calm.	1.0.	River, 26.944; Observatory, 26.878.
Nov. 30,	8 00 A. M.	26.786	26.973	33.8	33.7	......	32.5	......	......	......	......	......	......	NW. 3.	1.0.	Drift ice. Snowing and raining.
	10 00	....	26.987	36.0	35.3	......	33.5	......	......	35.5	33.5	......	......	NW. 1.	1.0.	Snowing.
	Noon.	....	27.007	37.8	38.2	......	35.8	......	......	37.4	35.3	......	......	NW. 1.	1.0.	Snowing.
	1 10 P. M.	....	27.008	30.0	31.5	......	31.0	......	......	26.2	24.6	......	......	NE. 4.	1.0.	
	2 00	....	27.007	24.0	26.0	......	24.0	......	......	21.8	20.3	....	......	N.NE. 4.	1.0.	Snowing.
	3 00	....	27.051	22.2	23.5	......	22.0	......	......	18.7	17.3	......	......	NE. 4.	1.0.	Snowing.

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1850.	h. m.			°	°	°	°	°	°	°	°	°				
Nov. 30,	5 00 P. M.	....	27.148	20.2	20.2	......	19.0	......	......	16.0	15.0	......	......	NE. 4.	Overcast.	Snowing.
	6 50	....	27.182	17.0	17.7	......	17.0	......	......	13.0	11.8	......	0.03	NE. 4.	1.0.	Snowing, 0 3 inch.
Dec. 1,	7 30 A. M.	....	27.338	13.3	14.0	......	13.2	......	......	12.9	11.0	......	......	NE. 3.	1.0.	Drift ice.
	9 45	....	27.532	15.0	15.0	......	14.3	......	......	12.2	9.6	......	......	N.NE. 3.	1.0.	
	Noon.	....	27.545	19.5	21.0	......	18.5	......	......	18.2	13.0	......	......	NE. 2.	0.8.	
	2 00 P. M.	....	27.540	17.3	16.0	......	15.0	......	......	32.8	17.5	......	......	NE. 2.	Clear.	
	5 00	....	27.550	10.0	9.0	......	8.0	......	......	7.0	5.8	......	......	NE. 2.	Clear.	
	9 30	....	27.582	13.0	12.5	......	12.0	......	......	7.5	5.5	......	......	NE. 1.	1.0.	
Dec. 2,	8 15 A. M.	....	27.428	18.8	18.7	......	18.0	......	......	9.6	8.0	......	......	Calm.	1.0.	Snowing; drift ice.
	10 00	....	27.438	19.0	20.0	......	19.0	......	......	11.2	9.0	......	......	Calm.	1.0.	Snowing.
	Noon.	....	27.374	19.5	19.5	......	18.5	......	......	14.5	12.0	......	......	NW. 1.	1.0.	Snowing.
	3 00 P. M.	....	27.318	21.0	21.5	......	21.0	......	......	15.0	13.3	......	......	Calm.	1.0.	Snowing.
	6 00	....	27.233	21.5	23.0	......	22.7	......	......	15.5	14.9	......	0.10	Calm.	1.0.	Snowing, 1 inch.
Dec. 3,	8 00 A. M.	....	27.050	23.0	25.2	......	24.8	......	......	18.4	16.7	......	1.18	Calm.	0.2.	Heavy snow; 13 inches.
	10 00	....	27.052	26.0	28.7	......	27.5	......	......	27.0	22.8	......	......	SE. 1.	0.8.	Drift ice.
	Noon.	....	27.044	32.0	35.0	......	32.5	......	......	31.0	25.4	......	......	W. 1.	0.9.	
	0 45 P. M.	....	27.018	35.6	38.5	......	37.0	......	......	51.3	35.2	......	......	SW. 1.	0.4.	
	3 00	....	26.984	28.6	29.5	......	28.5	......	......	29.7	27.5	......	......	NW. 1.	1.0.	
	6 00	....	26.948	27.3	28.3	......	21.5	......	......	25.8	24.5	......	......	NE. 1.	1.0.	Snowing.
	7 00	....	26.940	25.5	27.0	......	26.0	......	......	24.0	23.0	......	......	Calm.	1.0.	Snowing.
Dec. 4,	9 30 A. M.	....	27.272	3.0	4.5	......	4.5	......	......	— 2.0	— 5.0	......	0.27	N.NE. 5.	1.0.	Snow 3 inches. During the day broke up camp to move to Hell Gate.
	Noon.	....	27.346	10.0	18.0	......	17.0	......	......	— 2.0	— 4.7	......	......	N. 4.	1.0.	
	2 00 P. M.	....	27.348	1.0	5.5	......	5.8	......	......	— 2.5	— 5.9	......	......	NE. 4.	1.0.	
	5 00	....	27.412	— 1.0	3.0	......	2.7	......	......	— 6.2	— 7.8	......	......	NE. 3.	1.0.	
	8 00	....	27.488	—10.0	— 6.0	......	— 7.0	......	......	—12.0	......	......	......	Calm.	0.5.	During the night slept in 16 inches snow upon the pitched tent.
	10 00	....	27.512	—11.0	— 7.0	......	— 7.0	......	......	—18.0	......	......	......	W. 1.	0.1.	
Dec. 5,	7 30 A. M.	....	27.612	......	—23.0	......	—21.0	......	......	—35.0	......	......	......	Calm.	Clear.	
	7 45	....	......	......	......	......	......	......	......	—35.5	......	......	......	......	......	Black —35.5.
	9 00	....	......	......	......	......	......	......	......	—26.5	......	......	......	......	......	River frozen; sunrise.
	10 15	....	27.668	— 9.5	......	......	......	—11.5	—12.5	— 2.5	......	......	......	Calm.	Clear.	
	11 00	....	27.638	— 8.0	......	......	......	......	......	+14.0	......	......	......	......	......	At 6 p. m. —29.0.
Dec. 6,	7 00 A. M.	....	......	......	......	......	......	......	......	—19.0	......	......	......	......	......	Very cold night; concluded to remain.
	9 00	....	......	......	......	......	......	......	......	— 1.6	......	......	......	......	......	
	1 00 P. M.	....	27.412	— 5.0	— 7.8	......	......	......	......	......	......	......	......	Calm.	1.0.	Snowing.
	3 30	....	27.406	— 6.5	— 7.5	......	......	......	......	......	......	......	......	Calm.	1.0.	Snowing.

	5 [illegible]		27.[illegible]	+2.8	−7.9									Calm.	1.0.	Snowing.
	6 [illegible]		27.[illegible]	−3.6	−4.8								0.08	Calm.	1.0.	Snowing; ½ inch.
	7 15				+9.5								0.16	Calm.	1.0.	
Dec. 7,	8 30 A. M.		27.602	+9.5										Calm.	1.0.	Snow 1½ inch.
	10 30		27.596	9.5										Calm.	1.0.	Snowy.
	0 40 P. M.		27.592	14.5	13.3			15.5	16.0	13.7	11.5			Calm.	1.0.	Snowy.
	2 30		27.580	15.5	14.5			16.0	16.3	15.0	14.0		0.05	Calm.	1.0.	Snowy; ¼ inch.
	4 00		27.570	15.0	13.8			14.3	14.0	14.4	12.7			W. 1.	1.0.	
	6 00		27.519	15.0	15.0			15.3	14.7	14.2	13.3			Calm.	1.0.	
	7 45		27.507	14.7	14.0			14.2	14.0	14.0	12.7			Calm.	1.0.	
	9 15		27.486	11.2				10.9	10.2					Calm.	0.5.	
Dec. 8,	8 00 A. M.		27.582	24.0				22.8	22.6					W. 2.	0.9.	
	8 30		27.584	24.0	25.9			25.3	25.0	25.3	22.5			W.NW. 2.	0.9.	
	10 00		27.609	30.5	35.3			36.0	33.0	40.0	35.5			W SW. 2.	0.6.	
	0 15 P. M.		27.608	36.0	41.2			38.3		56.3	50.2			SW. 2.	0.3.	
	2 00		27.660	38.8	40.9			40.5	39.3	45.8	38.5			SW. 1.	0.9.	
	4 00		27.663	35.0	36.0			34.6	34.2	35.5	34.0			Calm.	1.0.	
	6 00		27.662	33.5	34.7			32.5	32.2	32.8	32.0			Calm.	1.0.	
	8 45		27.700	30.5	32.0			30.5	30.2	31.0	29.8			S. 1.	1.0.	
Dec. 9,	8 00 A. M.		27.714	31.0	32.0			29.0	28.5	29.0	27.8			Calm.	1.0.	Ice break; water level, 3 feet higher.
	10 00		27.716	32.0	34.5			34.7	32.0	35.0	32.0			S. 1.	1.0.	Drift ice.
	Noon.		27.711	36.5	39.0			39.3	37.3	40.2	35.5			S.SW. 1.	1.0.	Drift ice.
	1 00 P. M.		27.703	38.5	41.5			41.8	39.7	51.4	49.5			SW. 2.	0.8.	Drift ice.
	2 00		27.696	37.3	38.0			37.7	36.0	47.2	40.8			SW. 2.	0.2.	
	3 00		27.670	34.2	35.0			34.0	32.6	35.5	33.5			SW. 2.	0.1.	
	4 00		27.668	30.0	32.0			30.0	29.8	31.5	30.0			SW. 1.	0.1.	
	5 00		27.659	30.5	31.0			29.6	29.2	30.3	29.5			Calm.	1.0.	
	6 30		27.660	31.0	32.0			31.5	30.8	31.0	30.5			SW. 1.	1.0.	
Dec. 10,	8 00 A. M.		27.848	29.8	32.0			28.5	28.0	28.3	27.3		0.00	Calm.	1.0.	Snowing.
	10 00		27.858	30.0	31.0			31.5	30.5	31.0	28.8			Calm.	1.0.	Snowing; drift ice.
	0 30 P. M.		27.853	31.5	34.2			32.5	31.5	33.0	30.3			Calm.	1.0.	Drift ice.
	2 15		27.846	31.0	34.0			32.5	30.3	32.0	29.8			W. 1.	1.0.	Drift ice.
	4 00		27.838	30.7	32.0			29.8	28.5	30.0	29.0			N. 1.	1.0.	
	7 00		27.842	28.0	29.0			27.5	26.5	27.5	26.7			NE. 2.	1.0.	
Dec. 11,	8 20 A. M.		27.843	26.2	26.8			25.8	24.7	25.7	24.5			SW. 2.	1.0.	
	10 00		27.845	25.7	26.5			26.4	25.4	26.3	24.8			SW. 3.	1.0.	
	Noon.		27.820	28.0	30.9			29.7	28.7	29.5	26.7			SW. 2.	1.0.	
	2 00 P. M.		27.797	29.7	32.0			29.7	28.2	29.7	27.3			SW. 2.	1.0.	Drift ice.
	4 00		27.774	28.3	29.0			27.0	25.5	27.3	25.7			S. 2.	1.0.	Drift ice.
	6 00		27.798	26.0	27.0			25.7	24.5	26.0	25.2			S. 1.	1.0.	Drift ice.
Dec. 12,	8 30 A. M.		27.690	19.8	21.0			19.0	18.3	19.0	17.5			S. 1.	1.0.	
	11 20		27.632	25.0	29.0			23.5	22.7	23.5	20.0			Calm.	0.9.	
	2 35 P. M.		27.572	27.0	28.7			23.2	22.2	25.2	22.2			SW. 1.	0.8.	Clear at sunset.
	6 15		27.528	17.0	18.5			14.8	14.4	14.5	13.5			W. 1.	1.0.	
	8 00		27.598	18.0	19.0			16.3	15.5	15.6	14.7			SW. 1.	1.0.	
Dec. 13,	8 30 A. M.		27.536	14.8	15.5			12.3	11.5	12.2	10.5			Calm.	1.0.	Drift ice.
	10 00		27.528	16.0	17.0			14.3	14.0	15.3	12.2			S. 1.	0.6.	
	Noon.		27.515	20.8	22.3			21.8	21.3	27.3	20.8			S. 2.	0.2.	
	1 00 P. M.		27.488	23.5	23.3			24.2	23.5	32.5	24.8			S. 2.	0.1.	
	2 00		27.477	22.7	21.5			23.3	22.3	30.0	24.7			W. 1.	0.4.	
	3 00		27.474	22.5	24.0			22.7	22.3	22.3	21.6			S. 1.	1.0.	
	5 30		27.448	17.0	18.0			16.0	15.3	16.3	15.5			S SE. 2.	0.8.	
	7 00		27.445	16.8	18.0			14.9	13.8	14.0	11.8			Calm.	0.4.	

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1859.	A. M.			°	°	°	°	°	°	°	°	°				
Dec. 14,	8 00 A. M.	....	27.358	16.3	18.0	......	......	13.7	13.2	13.5	12.0	......	......	Calm.	1.0.	Snowing.
	9 40	....	27.340	18.0	20.0	......	......	18.0	17.5	17.4	15.0	......	......	Calm.	1.0.	
	Noon.	....	27.316	20.0	22.0	......	......	19.5	18.8	19.3	17.3	......	......	Calm.	1.0.	Snowing.
	2 08 P. M.	....	27.312	22.2	24.5	......	......	22.3	21.3	22.2	19.8	......	......	N. 1.	1.0.	Snowing.
	4 00	....	27.311	22.8	23.8	......	......	21.7	21.0	21.7	20.4	......	......	NW. 1.	0.9.	Snowing.
	7 30	....	27.322	22.7	23.7	......	......	22.3	22.5	21.5	22.3	......	0.09	Calm.	1.0.	Snowing; 1 inch.
Dec. 15,	8 15 A. M.	....	27.428	25.2	27.0	......	......	24.5	24.2	24.8	23.2	......	......	Calm.	0.9.	
	11 20	....	27.438	30.0	33.0	......	......	33.3	32.0	32.3	29.4	......	......	SW. 1.	0.9.	
	1 15 P. M.	....	27.430	32.5	35.0	......	......	36.6	35.2	37.7	34.3	......	......	Calm.	0.9.	
	3 00	....	27.432	33.3	35.5	......	......	33.5	32.5	34.5	32.8	......	0.01	Calm.	1.0.	Snowing; 0.10 inch.
	5 30	....	27.402	31.5	32.2	......	......	30.5	30.2	31.0	30.0	......	......	Calm.	1.0.	
	7 30	....	......	......	......	......	......	29.5	29.2	30.0	29.0	......	......	Calm.	1.0.	
Dec. 16,	8 20 A. M.	....	27.164	29.7	32.5	......	......	29.5	29.2	30.2	29.5	......	0.13	Calm.	1.0.	Snowing; 1½ inch.
	10 00	....	27.174	32.0	33.7	......	......	33.0	33.0	34.3	32.5	......	......	E. 1.	0.9.	
	Noon.	....	27.182	40.5	41.0	......	......	39.0	38.2	45.2	42.0	......	......	Calm.	0.8.	Upper wind; W. 2.
	2 40 P. M.	....	27.182	41.0	43.0	......	......	41.4	39.7	44.5	41.5	......	......	S. 2.	0.9.	Upper wind; W. 2.
	3 00	....	27.186	38.5	40.0	......	......	38.5	38.0	39.7	38.0	......	......	S.SE. 1.	1.0.	Upper wind; W. 3.
	5 00	....	27.190	33.5	35.5	......	......	34.0	33.2	34.5	33.5	......	......	SW. 2.	1.0.	
	8 20	....	27.220	32.5	35.5	......	......	32.5	32.0	32.5	32.0	......	0.03	W. 1.	1.0.	Raining.
Dec. 17,	6 30 A. M.	....	27.358	29.5	29.8	......	......	28.0	......	29.0	28.8	......	......	E. 2.	0.5.	Upper; W.NW. 2.
	9 00	....	27.376	24.0	24.3	......	......	25.0	24.5	26.0	25.0	......	......	NW. 2.	Clear.	
	11 00	....	27.428	37.0	39.0	......	......	36.5	36.0	48.0	39.5	......	......	W. 1.	0.2.	
	1 10 P. M.	....	27.413	33.0	33.6	......	......	33.5	32.5	35.3	32.8	......	......	N.NW. 2.	0.3.	
	2 15	....	27.412	32.5	33.2	......	......	34.2	32.0	35.5	34.5	......	......	N. 3.	0.8.	
	4 45	....	27.408	27.0	28.5	......	......	27.3	26.5	28.3	27.0	......	......	NW. 2.	0.4.	
	7 30	....	27.523	27.5	28.5	......	......	27.3	26.0	28.0	27.0	......	......	NE. 2.	1.0.	
Dec. 18,	7 30 A. M.	....	27.756	13.5	11.0	......	......	10.5	10.3	11.5	9.5	......	......	N.NW. 2.	0.3.	Light snowing.
	10 15	....	27.767	20.8	22.0	......	......	20.0	......	20.2	17.5	......	......	N. 2.	0.9.	
	11 45	....	27.746	25.5	27.0	......	......	24.5	24.3	26.0	24.7	......	......	SE. 2.	0.9.	Upper; SW. 2.
	1 00 P. M.	....	27.728	24.5	25.0	......	......	28.0	28.0	39.7	29.5	......	......	SE. 2.	Clear.	
	2 10	....	27.712	25.0	24.7	......	......	24.5	22.5	41.5	35.5	......	......	NE. 2.	Clear.	
	3 00	....	27.707	22.2	22.2	......	......	21.8	20.7	24.6	19.8	......	......	Calm.	Clear.	
	5 00	....	27.668	13.7	14.0	......	......	11.7	11.2	13.0	12.0	......	......	W. 1.	Clear.	
	7 00	....	27.688	9.2	9.0	......	......	7.5	7.3	8.3	6.2	......	......	N.NW. 2.	Clear.	
	8 00	....	27.686	6.0	6.5	......	......	5.8	5.5	6.0	5.8	......	......	N. 1.	Clear.	

	9 15	......	27.700	9.0	11.0	......	......	4.0	......	4.0	3.0	......	......	Calm.	Clear.	To midnight.
Dec. 19,	6 00 A.M.	......	27.744	13.0	14.5	......	......	10.0	......	9.3	8.0	......	......	N. 1.	1.0.	Overclouded towards morning.
	9 05	......	27.736	14.5	13.0	......	......	13.0	......	19.5	10.6	......	......	......	0.2.	
	11 00	......	27.710	24.0	26.5	......	......	22.5	......	29.8	21.4	......	......	NW. 1.	0.1.	
	0 22 P.M.	......	27.708	26.8	27.0	......	......	25.5	......	36.0	30.2	......	......	Calm.	Clear.	
	1 00	......	27.696	24.0	25.0	......	......	26.8	26.5	38.0	28.5	......	......	Calm.	0.1.	
	2 10	......	27.660	24.8	24.4	......	......	24.8	23.5	35.8	30.8	......	......	NE. 1.	0.2.	
	3 00	......	27.648	22.5	22.0	......	......	22.2	21.5	27.5	22.8	......	......	Calm.	0.1.	
	5 50	......	27.638	12.8	10.0	......	......	10.5	10.4	11.5	10.5	......	......	Calm.	0.1.	
	7 28	......	27.624	9.5	7.8	......	......	6.2	7.0	7.0	6.2	......	......	Calm.	0.1.	
	9 00	......	27.672	7.5	7.5	......	......	5.5	......	5.5	4.7	......	......	Calm.	Clear.	
Dec. 20,	7 10 A.M.	......	27.576	4.8	4.5	......	......	4.3	......	4.5	4.4	......	......	Calm.	Clear.	Wet bulb protected by ice.
	9 40	......	27.554	14.0	15.0	......	......	12.5	13.0*	13.0	10.8	......	......	Calm.	1.0.	
	11 00	......	27.540	17.0	18.0	......	......	16.2	16.5	16.5	14.5	......	......	NW. 1.	1.0.	
	1 00 P.M.	......	27.502	20.5	22.0	......	......	20.2	20.8	19.7	17.5	......	......	Calm.	1.0.	
	2 40	......	27.480	22.0	23.0	......	......	21.2	21.8	21.0	19.5	......	......	Calm.	1.0.	
	6 00	......	27.470	22.5	22.5	......	......	19.0	19.5	19.0	18.9	......	......	NE. 1.	1.0.	
	8 30	......	27.458	18.5	19.0	......	......	12.5	12.5	12.8	12.0	......	......	NE. 1.	1.0.	
Dec. 21,	8 07 A.M.	......	27.480	9.0	9.0	......	......	6.0	6.3	6.2	5.9	......	......	......	......	
	9 34	......	27.486	15.8	16.0	......	......	14.5	15.8	15.4	12.8	......	......	S SE. 1.	0.8.	
	11 14	......	27.540	30.5	35.0	......	......	25.5	26.5*	32.0	24.8	......	......	S SE. 1.	0.4.	
	1 00 P.M.	......	27.514	29.0	29.8	......	......	27.8	29.5*	44.2	36.8	......	......	S.SE. 1.	0.2.	
	2 00	......	27.488	27.4	27.5	......	......	25.0	23.5*	35.5	31.0	......	......	......	0.2.	
	3 00	......	27.512	24.5	24.5	......	......	22.8	22.0	24.5	22.2	......	......	NW. 2.	0.4.	
	5 52	......	27.482	20.0	21.0	......	......	17.5	17.8	18.2	17.5	......	......	NW. 1.	Clear.	
	8 34	......	27.526	13.5	14.0	......	......	7.5	7.5	8.5	7.8	......	......	NW. 1.	Clear.	
Dec. 22,	8 00 A.M.	......	27.518	15.0	15.2	......	......	12.5	12.4	12.5	11.5	......	......	......	1.0.	Snowing.
	9 28	......	27.514	18.5	19.0	......	......	15.8	15.5	15.5	13.8	......	......	W. 1.	1.0.	
	11 00	......	27.514	23.5	26.5	......	......	21.0	20.8	23.4	18.8	......	......	W.SW. 1.	0.8.	
	0 27 P.M.	......	27.472	26.0	29.2	......	......	24.0	22.0	26.4	22.0	......	......	W.SW. 1.	0.9.	
	1 00	......	27.452	27.5	29.8	......	......	23.2	22.0	25.0	21.8	......	......	S SE. 1.	1.0.	
	3 00	......	27.428	26.8	27.8	......	......	22.8	21.0	25.0	22.8	......	......	S. 1.	1.0.	
	5 20	......	27.490	17.8	18.8	......	......	14.0	14.0	15.0	14.0	......	......	NW. 1.	Clear.	
	7 23	......	26.392	13.5	14.0	......	......	9.0	9.0	10.0	9.0	......	......	NW. 1.	Clear.	
	8 30	......	27.392	12.5	12.8	......	......	8.0	8.0	8.0	7.0	......	......	NW. 1.	Clear.	
Dec. 23,	7 47 A.M.	......	27.368*	1.8	—2.0	......	......	2.5	—2.4	— 2.0	— 2.8	......	......	Calm.	0.7.	
	9 46	......	27.338	9.5	13.0	......	......	9.0	13.0?	15.0	7.0	......	......	SE. 1.	0.6.	
	11 17	......	27.312	15.0	16.8	......	......	11.8	12.8	13.4	10.0	......	......	SE. 1.	1.0.	
	1 00 P.M.	......	27.288	24.0	31.0	......	......	18.0	20.0	20.8	15.8	......	......	SE. 1.	1.0.	
	3 00	......	27.264	22.5	25.0	......	......	18.5	18.0	19.5	17.0	......	......	SE. 1.	0.6.	
	5 18	......	27.238	20.0	21.0	......	......	14.0	13.8	14.5	13.8	......	......	NW. 1.	0.5.	
	7 42	......	27.154	13.0	13.5	......	......	9.0	9.0	9.0	8.0	......	......	N.NE. 1.	Clear.	
Dec. 24,	7 30 A.M.	......	26.982	14.0	15.0	......	......	11.8	11.5	11.8	11.0	......	......	S.SE. 1.	1.0.	
	9 53	......	26.956	21.4	22.8	......	......	16.0	15.5	16.5	15.9	......	......	N.NW. 1.	1.0.	
	11 11	......	26.962	22.0	24.0	......	......	19.0	18.0	20.0	18.0	......	......	S. 1.	1.0.	
	1 00 P.M.	......	26.928	22.5	24.0	......	......	22.0	20.8	22.0	19.5	......	......	S. 1.	1.0.	
	3 04	......	26.836	26.4	30.0	......	......	24.0	22.8	24.0	22.0	......	......	S. 1.	1.0.	
	6 00	......	26.838	24.5	25.5	......	......	21.5	21.0	21.0	20.0	......	......	S. 1.	1.0.	Snowing.
	8 20	......	26.834	25.2	27.0	......	......	21.5	20.0	21.5	20.5	......	......	S. 1.	1.0.	Snowing.
Dec. 25,	7 30 A.M.	......	26.922	25.0	25.0	......	......	23.0	22.5	23.2	22.5	......	0.07	S. 1.	1.0.	Snowing; ¾ inch.
	9 35	......	26.934	26.0	28.0	......	......	26.5	26.0	27.0	24.8	......	......	S. 1.	1.0.	
	11 20	......	26.948	38.8	36.0	......	......	35.0	34.5	37.8	32.0	......	......	W. 1.	1.0.	
	Noon.	......	26.956	36.8	40.0	......	......	37.8	37.0	44.0	37.9	......	......	N.NW.	1.0.	

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1859.	A. m.			°	°	°	°	°	°	°	°	°				
Dec 25,	1 27 P. M.	....	26.962	35.5	37.5	......	......	36.2	33.0	41.6	35.8	......	......	N.NW.	0.6.	
	3 15	....	26.980	32.0	33.8	......	......	31.5	31.0	32.5	30.4	......	......	Calm.	0.6.	
	5 45	....	27.028	30.5	31.5	......	......	29.5	29.0	30.0	29.8	......	......	....	....	Snowing.
	8 08	....	27.058	31.4	34.0	......	......	29.4	28.8	29.8	29.5	......	0.01	....	....	Snowing.
Dec. 26,	7 30 A. M.	....	27.186	25.5	26.0	......	......	21.0	23.0	23.5	22.5	......	......	....	1.0.	
	9 42	....	27.196	29.5	32.2	......	......	28.3	28.3	26.0	26.0	......	......	W.SW.	1.0.	Snowing.
	11 00	....	27.212	32.0	34.0	......	......	30.5	30.0	29.5	28.8	......	......	W. 1.	1.0.	Snowing.
	Noon.	....	27.196	34.5	36.8	......	......	31.5	30.5	33.0	29.0	......	......	S.SW.	1.0.	
	1 08 P. M.	....	27.178	32.2	33.5	......	......	33.0	32.0	38.8	32.6	......	......	W.SW. 1.	0.6.	
	3 17	....	27.168	28.8	31.0	......	......	27.0	26.3	28.4	26.5	......	......	W.SW. 1.	0.3.	
	5 00	....	27.171	20.2	21.0	......	......	19.0	18.5	20.0	19.3	......	......	Calm.	0.2.	
	8 00	....	27.164	19.0	19.5	......	......	16.4	16.0	15.5	15.0	......	......	Calm.	Clear.	
Dec. 27,	7 28 A. M.	....	27.276	21.5	22.0	......	......	18.5	18.0	18.8	17.8	......	......	W. 1.	1.0.	
	9 18	....	27.292	22.5	23.0	......	......	20.5	19.8	20.3	19.0	......	......	W.NW. 1.	1.0.	
	11 24	....	27.292	25.5	28.0	......	......	25.5	23.5	25.4	22.0	......	......	W.SW. 1.	1.0.	
	1 13 P. M.	....	27.282	28.0	30.5	......	......	27.2	26.5	33.5	26.8	......	......	W.SW. 1.	1.0.	
	3 03	....	27.274	28.5	26.0	......	......	24.0	22.8	26.0	23.0	......	......	W.SW. 1.	0.5.	
	5 30	....	27.250	15.0	15.0	......	......	11.5	11.0	12.0	11.5	......	......	Calm.	Clear.	
	9 48	....	27.234	15.0	16.0	......	......	11.0	10.5	10.8	10.0	......	......	W.SW. 1.	1.0.	
Dec. 28,	7 30 A. M.	....	27.298	14.8	15.0	......	......	10.2	9.8	10.0	9.0	......	......	N.NW. 1.	1.0.	
	10 25	....	27.372	18.0	19.0	......	......	15.5	15.0	15.8	14.0	......	0.01	....	1.0.	Snowing.
	Noon.	....	27.392	14.4	15.0	......	......	21.0	20.4	22.0	18.8	......	......	W. 1.	1.0.	
	2 07 P. M.	27.090	27.398	26.0	28.0	......	......	23.0	22.2	24.0	20.6	......	......	W. 1.	1.0.	
	3 11	27.106	27.382	26.4	28.5	......	......	21.8	20.8	21.8	20.0	......	......	W. 1.	1.0.	
	7 00	27.150	27.464	25.0	26.0	......	......	19.5	19.0	19.5	19.0	......	......	W. 1.	1.0.	
Dec. 29,	7 30 A. M.	27.180	27.506	19.5	19.0	......	......	15.0	14.5	15.0	14.0	......	......	W. 1.	1.0.	
	9 09	27.158	27.450	19.5	20.8	......	......	16.8	16.0	16.5	15.3	......	......	S.SW. 1.	1.0.	
	1 15 P. M.	27.137	27.463	28.0	30.8	......	......	28.5	26.5	28.8	26.7	......	......	Calm.	1.0.	
	3 15	27.150	27.453	27.3	30.0	......	......	27.7	26.0	28.4	26.7	......	......	Calm.	1.0.	Snowing.
	4 50	27.185	27.444	27.3	28.5	......	......	25.5	24.0	25.7	25.0	......	......	NW. 1.	1.0.	
	8 20	27.203	27.446	21.7	22.0	......	......	20.3	......	20.8	19.8	......	......	NE. 1.	1.0.	
Dec. 30,	7 45 A. M.	27.218	27.508	20.0	21.5	......	......	15.3	......	15.0	14.0	......	......	W. 1.	1.0.	
	10 00	27.243	27.516	21.3	22.7	......	......	20.0	19.5	19.7	17.3	......	......	Calm.	1.0.	
	1 00 P. M.	27.236	27.510	28.5	33.5	......	......	29.3	28.5	31.0	25.5	......	......	Calm.	1.0.	
	3 40	27.230	27.510	27.0	28.5	......	......	26.7	26.0	27.7	25.8	......	......	E. 1.	1.0.	

Dec. 31,	6 40	27.240	27.518	22.0	24.0	......	......	22.5	22.0	23.0	22.0	......	......	Calm.	1.0.	
	8 20 A. M.	27.164	27.485	8.0	9.5	......	......	3.5	......	3.5	2.0	......	......	Calm.	0.4.	
	9 45	......	27.464	12.5	15.0	......	......	19.5	......	17.8	12.5	......	......	E. 1.	0.4.	
	11 00	......	27.466	24.0	26.0	......	......	20.0	......	24.0	18.3	......	......	S. 1.	0.5.	
	Noon.	......	27.446	24.5	25.5	......	......	26.0	25.0	32.5	25.3	......	......	S. 2.	0.3.	
	1 10 P. M.	......	27.420	23.7	25.0	......	......	26.3	24.9	35.5	27.5	......	......	S. 2.	0.1.	
	2 00	......	27.414	24.3	24.8	......	......	24.0	22.0	25.0	21.5	......	......	S.	0.1.	
	3 03	......	27.412	22.5	24.0	......	......	22.0	20.8	25.4	22.5	......	......	S.	0 4.	
	4 30	......	27.404	15.5	17.0	......	......	13.5	13.0	14 0	13.0	......	......	N. 1.	0.1.	
	7 00	......	27.390	8.5	9.0	......	......	6 5	6.5	7.3	6.5	......	......	Calm.	1.0.	Moon's halo.
	8 22	......	27 368	9.0	9.0	......	......	5.0	5.0	5.0	4.3	......	......	Calm.	Clear.	
	1860.															
Jan. 1,	8 20 A. M.	......	27.283	16.3	18.0	......	......	14.3	..	14.0	12.0	......	......	Calm.	1.0.	Snowing.
	0 45 P. M.	......	27 204	22.8	24.5	......	......	23.3	23.0	22.3	19.8	......	......	S. 1.	1.0.	Snowing.
	3 20	......	27.190	23.0	27.0	......	......	23.3	23.1	23.5	22.0	......	......	Calm.	1.0.	Snowing.
	6 00	......	27.172	23.0	24.0	......	......	23.3	23.0	23.0	22.0	......	......	Calm.	1.0.	Snowing.
	8 10	......	27.158	22.0	23 0	......	......	22 5	22.5	22 6	21.5	......	0.12	Calm.	1.0.	Snowing; 1¼ inch.
Jan. 2,	8 20 A. M.	......	27.174	26.5	26.0	......	......	24.5	24.0	24.5	23.5	......	0.34	Calm.	1.0.	Snowing; 3¼ inch.
	10 40	......	27.176	28 5	31.0	......	......	31.0	31.0	31.3	27.3	......	......	Calm.	0.9.	
	Noon.	......	27.178	33.8	35.5	......	......	36.5	36.0	37.0	32.5	......	......	Calm.	0.9.	
	1 30 P. M.	......	27.184	35.5	39.0	......	......	38.5	37.5	50.2	44.5	......	......	W. SW. 2.	0 5.	
	3 00	......	27.192	34.7	36.5	......	......	36.5	35.0	39.5	36.0	......	......	Calm.	0.7.	
	4 30	......	27.223	31.5	32.0	......	......	31.5	31.3	32 0	31.0	......	......	Calm.	1.0.	
	7 00	......	27.210	30.0	30.8	......	......	30.0	29.5	30.3	29 5	......	......	Calm.	1.0.	
	8 40	......	27.230	30.3	31.0	......	......	30.5	30.0	30.5	30.0	......	......	Calm.	1.0.	Snowing.
Jan. 3,	8 00 A. M.	......	27.324	30.0	30.5	......	......	30.3	30.0	30.8	29.7	......	0.14	Calm.	1.0.	Snowing; 1½ inch.
	9 30	......	27.340	31.5	32.5	......	......	33.3	33.0	32 5	31.0	......	......	Calm.	1.0.	
	0 30 P. M.	......	27.336	37.5	40 3	......	......	40.5	40.0	39.5	36.5	......	......	Calm.	1 0.	
	2 30	......	27.332	37.5	39.0	......	......	38 0	37.7	39.5	37.5	......	......	Calm.	1.0.	
	4 00	......	27.338	35.0	36.0	......	......	35.5	35.5	36.5	35.0	......	......	Calm.	1.0.	Raining.
	6 00	......	27.330	32.5	33.5	......	......	32.5	32.0	33.0	32 0	......	......	Calm.	1.0.	Raining.
	7 30	......	27.323	32.0	33.0	......	......	33.0	32 0	32 0	31.5	......	0.20	Calm.	1.0.	Raining.
Jan. 4,	7 50 A. M.	......	27.318	30.5	30.7	......	......	30.2	29.5	30.5	29.5	......	......	Calm.	1.0.	Snowing.
	10 15	......	27.324	33 0	33 5	......	......	35 0	35.0	35.2	32.7	......	......	Calm.	1.0.	Raining.
	0 26 P. M.	......	27.252	35.8	37.2	......	......	37.0	36.5	36.8	34.5	......	......	Calm.	1.0.	Raining.
	2 10	......	27.246	34.8	35.8	......	......	34.5	34.5	35 3	33.9	......	0.04	Calm.	1.0.	Raining.
	3 10	......	27.254	36.5	38.0	......	......	36.0	36.0	39.0	35.7	......	......	Calm.	0.9.	
	4 20	......	27.244	33.0	34.0	......	......	34.0	34.0	34.5	33.7	......	......	W. 1.	0.6.	
	7 30	......	27.214	32.5	33.0	......	......	32.5	32.5	32.5	32.0	......	......	Calm.	1.0.	Raining.
	8 45	......	27.203	33.0	33.3	......	......	32.3	32.0	32.5	31.7	......	......	W. 1.	1.0.	Raining.
Jan. 5,	8 15 A. M.	......	27.056	32.3	33.0	......	......	32 5	32.3	32.5	31.6	......	0.03	Calm.	1.0.	Snowing; 0.2 inch.
	10 00	......	27.056	33.0	34 0	......	......	34.5	34 3	35.4	33.7	......	......	E. 1.	1 0.	
	0 10 P. M.	......	27.046	37.0	39.0	......	......	39.5	39.3	41.3	38.7	......	......	Calm.	0.9.	
	2 15	......	27.038	35 2	36.0	......	......	36 0	36.0	35.6	34.0	......	......	Calm.	1.0.	Raining.
	4 00	......	27.049	34.0	35 0	......	......	34.0	34 0	34.5	33 2	......	......	W. 2.	0.8.	
	6 00	......	27.048	31.0	32.0	......	......	31.5	31.3	31.3	30 5	......	......	W. 2.	0.8.	
	10 00	......	27.048	30.8	30.8	......	......	30.8	30.0	30.3	29.5	......	......	W. 1.	0.8.	
Jan. 6,	8 15 A. M.	......	26.675	28 5	29 0	......	......	28.5	28.3	28.7	27 8	......	......	N. 1.	1.0.	Snow.
	9 40	......	26.671	29.3	30.3	......	......	30.0	29.8	29.8	29.0	......	0.23	Calm.	1 0.	Snow; 2¼ inches.
	10 45	......	26.668	31.0	32 0	......	......	31.2	31.0	30.3	29.2	......	......	W. 1.	0.9.	
	0 05 P. M.	......	26.646	33.5	34 0	......	......	35.0	35.0	33.8	31.5	......	......	W 2.	0.9.	
	1 30	......	26.574	34.5	35.0	......	......	33.5	35.0	34.6	33.0	......	......	Calm.	0.9.	Fine hail.
	3 10	......	26.564	33.0	34.0	......	......	33.6	33.4	32.0	32.9	......	......	Calm.	1.0.	Snowing.

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1860.	A. m.			°	°	°	°	°	°	°	°	°				
Jan. 6,	5 00 P. M.	....	26.555	32.9	33.0	......	......	33.0	33.0	32.3	31.5	......	0.11	Calm.	1.0.	Snowing; 1¼ inch.
	7 05	....	26.560	32.3	33.0	......	......	33.5	33.3	32.5	31.7	......	......	Calm.	1.0.	Snowing.
	10 25	....	26.684	32.3	33.0	......	......	32.3	32.0	32.5	31.5	......	0.12	SE. 2.	1.0.	Snowing; 1.6 inch.
Jan. 7,	0 15 A. M.	....	26.718	32.7	33.0	......	......	31.0	31.0	32.3	31.0	......	......	W. 2.	1.0.	
	1 20	....	26.756	32.0	33.0	......	......	31.0	30.5	31.0	30.5	......	......	W. 2.	1.0.	
	7 45	....	26.888	25.5	26.0	......	......	25.5	25.3	26.3	25.3	......	......	W. 2.	0.8	
	9 30	....	26.904	28.0	29.0	......	......	28.7	28.7	29.0	27.0	......	0.01	Calm.	1.0.	Snowing; ½ inch.
	11 30	....	26.902	33.0	35.0	......	......	35.0	37.0	34.0	31.0	......	......	Calm.	1.0.	Snowing.
	2 00 P. M.	....	26.898	34.0	35.0	......	......	33.2	32.0	32.3	31.5	......	0.02	Calm.	1.0.	Snowing; ¼ inch.
	4 00	....	26.900	32.0	33.0	......	......	32.0	31.0	32.2	30.0	......	0.02	Calm.	1.0.	Snowing; 0.5 inch.
	5 30	....	26.893	30.5	31.0	......	......	29.3	29.0	29.5	28.5	......	...	Calm.	1.0.	Snowing.
	Midnight.	....	26.890	24.3	25.3	......	......	25.0	24.5	25.0	24.0	......	0.05	Calm.	1.0.	Snowing; ¼ inch.
Jan. 8,	8 30 A. M.	....	26.894	21.7	22.0	......	......	21.2	21.0	22.2	21.0	......	0.17	W. 1.	0.5.	Snowing; 2 inches.
	10 00	....	26.907	28.0	29.0	......	......	29.0	29.0	28.5	25.5	......	......	W.SW. 2.	0.5.	
	Noon.	....	26.894	32.0	33.0	......	......	35.5	35.3	34.0	31.5	......	......	W.SW. 2.	0.7.	
	2 00 P. M.	....	26.891	32.7	34.5	......	......	34.5	33.5	33.5	32.7	......	......	W.SW. 1.	0.8.	Snowing.
	3 30	....	26.890	31.0	32.0	......	......	29.2	28.3	30.4	28.5	......	0.02	W. 1.	0.9.	Snowing; ¼ inch.
	5 45	....	26.884	26.3	26.5	......	......	26.3	26.0	26.7	25.8	......	......	NW. 1.	0.9.	
	7 35	....	26.876	24.0	24.0	......	......	24.0	23.8	24.3	23.5	......	......	N. 1.	0.8.	
	Midnight.	....	26.808	22.0	23.0	......	......	22.3	22.0	22.0	21.5	......	0.02	Calm.	1.0.	Snow; ½ inch.
Jan. 9,	1 00 A. M.	....	26.798	24.5	25.0	......	......	23.0	23.0	23.0	22.2	......	......	W. 1.	1.0.	Snow.
	7 20	....	26.857	25.0	25.0	......	......	24.0	24.0	25.0	24.0	......	0.20	N.NW. 3.	1.0.	Snow; 2.1 inches.
	9 20	....	26.970	23.5	23.5	......	......	23.0	22.7	25.0	23.7	......	......	N.NW. 2.	0.8.	
	10 40	....	26.986	25.0	25.3	......	......	25.0	24.5	26.5	24.0	......	......	W.NW. 3.	0.9.	
	Noon.	....	27.060	25.3	26.3	......	......	26.3	24.0	31.5	25.4	......	......	NW. 4.	0.8.	
	2 10 P. M.	....	27.138	27.0	27.2	......	......	26.2	23.3	29.4	25.2	......	......	W.NW. 3	0.7.	
	3 00	....	27.147	22.5	22.5	......	......	23.2	20.3	25.5	23.0	......	......	W.NW. 2.	0.7.	
	4 00	....	27.157	19.8	20.0	......	......	20.2	18.5	21.3	19.5	......	......	W.NW. 2.	0.6.	
	5 35	....	27.186	16.0	16.0	......	......	15.0	14.2	15.3	14.0	......	......	W.NW. 1.	0.7.	
	8 40	....	27.196	15.0	15.5	......	......	14.0	13.7	14.0	13.0	......	......	Calm.	1.0.	
Jan. 10,	2 00 A. M.	....	27.196	12.5	12.5	......	......	11.0	11.0	11.5	10.3	......	......	W. 1.	0.9.	
	7 30	....	27.208	1.0	0.0	......	......	0.5	0.5	−0.5	−1.0	......	......	W. 1.	0.2.	
	9 00	....	27.242	−1.0	−1.0	......	......	−1.0	−1.0	0.0	−2.0	......	......	Calm.	Clear.	
	9 30	....	27.248	5.5	7.0	......	......	9.7	......	16.7	6.5	......	......	Calm.	Clear.	
	10 00	....	27.260	8.3	10.0	......	......	13.7	......	25.2	13.5	......	......	Calm.	Clear.	

	11 00		27.[illegible]	17.[illegible]	[illegible].7			17.0		[illegible]	20.3			Calm.	0.1.	
	0 10 P. M.		27.[illegible]	[illegible]	21.0			21.5		[illegible]	[illegible]			NE. 1.	1.0.	
	2 00		27.[illegible]	23.5	25.2			24.5	23.0	27.5	24.0			W. 1.	1.0.	
	4 20		27.322	17.0	17.0			15.5	14.5	15.3	14.7			N.NE. 2.	0.9.	
	6 00		27.380	13.3	13.5			11.5	10.3	11.5	10.5			NE. 2.	0.5.	
	8 05		27.386	12.5	13.0			11.2	10.7	11.2	10.0			N. 2.	1.0.	
Jan. 11,	8 00 A. M.		27.498	8.0	8.5			6.0		6.0	4.8			N.NW. 2.	1.0.	
	9 00		27.515	12.0	14.0			10.2	10.0	11.2	8.2			Calm.	1.0.	
	11 00		27.531	19.8	23.5			21.0	20.3	22.8	17.6			Calm.	0.9.	
	Noon.		27.530	24.0	26.0			22.2	20.2	23.8	18.8			Calm.	1.0.	
	2 00 P. M.		27.528	27.0	29.0			26.0	25.0	30.0	25.5			NW. 1.	0.8.	Max of black and naked : 9.0, 30.0.
	4 00		27.523	22.0	24.0			23.0	22.8	24.0	22.5			N.NW. 2.	0.9.	
	6 00		27.525	20.5	21.0			19.5	17.5	19.5	18.5			NE 1.	1.0.	
	8 00		27.518	17.0	17.5			15.7	15.0	15.5	14.5			N 1.	1.0.	
Jan. 12,	8 00 A. M.		27.432	21.0	22.0			21.0	20.5	21.2	20.0			Calm.	1.0.	
	10 05		27.432	26.0	27.0			26.0	25.5	27.5	25.3			Calm.	1.0.	
	0 50 P. M.		27.438	31.0	32.0			32.5	31.5	33.0	30.5			Calm.	1.0.	
	2 30		27.433	33.0	34.3			34.2	32.7	35.3	33.7			Calm.	1.0.	
	5 30		27.424	31.0	32.0			31.7	31.3	32.3	31.5			W.NW. 1.	1.0.	
	7 50		27.424	30.0	31.0			31.3	30.5	31.5	31.0			Calm.	1.0.	
Jan. 13,	8 00 A. M.		27.388	21.0	21.3			22.5	22.5	23.5	23.0			SW. 1.	1.0.	
	9 10		27.393	24.7	26.0			29.0	...	33.5	27.5			SW. 1.	0.1.	
	10 00		27.398	34.3	36.0			42.0	44.5*	54.3	39.0			W. 2.	0.3.	* The wood-work of the wet bulb heated by the sun.
	11 00		27.397	38.0	39.3			39.5	35.5	41.5	37.8			W. 4.	0.5.	
	Noon.		27.396	39.3	40.0			40.2	36.2	41.7	38.3			W. 3.	0.8.	
	2 00 P. M.		27.394	36.0	37.3			38.0	35.5	38.0	36.5			W. 4.	1.0.	
	4 00		27.390	33.0	34.0			34.0	31.0	35.0	34.0			W 3.	1.0.	
	6 00		27.372	31.0	31.7			32.0	31.0	32.0	31.0			W. 2.	1.0.	
	7 50		27.372	31.5	32.3			33.0	32.5	34.0	33.0			W. 2.	1.0.	
Jan. 14,	6 40 A. M.		27.376	28.5	29.0			29.0		29.0	28.0			W. 2.	1.0.	
	8 40		27.380	30.0	31.5			30.6	30.4	31.5	30.0					
	10 21		27.380	33.9	34.5			35.0	34.0	35.5	33.6			S.SE. 1.	1.0.	
	0 08 P. M.		27.348	38.5	40.5			40.0	37.5	42.0	39.0			Calm.	1.0.	
	2 32		27.336	40.5	42.0			41.0	38.0	42.3	40.5			N.NW. 1.	1.0.	
	4 33		27.262	37.5	38.5			38.5	35.8	39.5	38.8			S.SE. 1.	1.0.	
	6 27		27.242	38.0	38.5								0.10	Windy.	1.0.	Rainy.
Jan. 15,	7 30 A. M.		27.392	31.0	32.0			30.6	30.0	32.5	32.0			Calm.	1.0.	
	10 40		27.462	39.9	41.5			41.0	37.0	49.0	43.0			N NE. 1.	0.8.	
	11 47		27.476	40.9	42.0			42.5	36.0	48.8	43.0			N.NW. 2.	0.8.	
	1 20 P. M.		27.522	39.5	39.5			44.0	37.0	54.5	48.3				0.5.	
	2 29		27.540	37.5	37.5			40.4	33.8	45.0	41.5			W. 1.	0.5.	
	4 22		27.584	32.8	32.5			33.0	29.8	35.4	34.0			Calm.	0.5.	
	6 41		27.586	22.8	22.8			23.0	22.0	24.0	23.0			Calm.	Clear.	
	9 00		27.588	19.5	19.0			19.3	18.0	20.5	19.5			Calm.	Clear.	
Jan. 16,	8 08 A. M.		27.628	9.8	9.8			9.5	9.0	9.5	9.0			Calm.	0.4.	
	10 03		27.640	21.0	22.0			23.0	22.0	31.5	22.5			Calm.	0.4.	
	11 06		27.692	32.0	35.0			30.0	29.0	44.5	33.0			Calm.	0.4.	
	Noon.		27.612	32.5	34.0			36.0*	30.0	38.0	30.4			S.SE. 1.	0.4.	* Doubtful.
	1 03 P. M.		27.562	32.5	33.8			34.0	31.0	43.0	35.0			Calm.	0.3.	Max. of black 51, naked 43.
	2 03		27.544	35.8	35.5			34.0	31.0	41.0	39.0			Calm.	0.1	
	4 05		27.544	27.2	27.0			26.5	26.0	28.0	26.8			S.SW. 1.	0.3.	
	6 38		27.558	17.5	17.0			17.8	17.0	19.0	18.5			Calm.	Clear.	
	10 51		27.520	12.0	11.5											

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1860.	h. m.			°	°	°	°	°	°	°	°	°				
Jan. 17,	7 40 A. M.	....	27.550	4.5	4.0	......	......	3.5	4.0	3.5	2 6	......	......	Calm.	0.3.	
	10 19	....	27.654	23.5	24.5	......	......	22.0	....	29.5	20.0	......	......	S. 1.	0.4.	
	0 34 P. M.	....	27.630	36.0	37 8	......	......	36.0	33.0	44.0	34.0	......	......	S.-E.	0.7.	
	1 33	....	27.604	34.8	35 5	......	......	36.0	33 0	47.5	40.0	......	......	S.SE.	0.5.	
	2 40	....	27.590	33.5	33 2	......	......	34.0	31.9	37.0	34.5	......	......	W. 1.	Clear.	
	4 04	....	27.592	28.5	29.0	......	......	26 4	25.0	28.0	26.0	......	......	W. 1.	Clear.	
	5 54	....	27.586	17.5	16.5	......	......	19.5	18.8	21.0	20.0	......	......	W. 1.	0.2.	
	8 40	....	27.570	13.2	13.0	......	......	13.8	13.0	14.5	14.0	......	......	W. 1.	0.2.	
Jan. 18,	7 45 A. M.	....	27.436	7.0	6.8	......	......	5.0	5.0	4.5	4.0	......	......	W. 1.	0.6.	
	10 30	....	27.396	24.0	27.0	......	......	22 5	26.5*	32.8	32.0	......	......	W. 1.	0.5.	* Sun.
	Noon.	....	27.400	31.5	32 8	......	......	31.4	30.3	37 0	30.0	......	......	S SW. 1.	0.7.	
	1 46 P. M.	....	27.372	36.5	38.0	......	......	37.0	32.5	45.0	37.5	......	......	S SW. 1.	0.7.	
	4 00	....	27.350	30.6	31.0	......	......	30.2	27.5	31.8	30.0	......	......	S SW. 1.	0.7.	
	6 35	....	27.322	27.5	28.0	....	......	28.0	26 5	28.0	27.2	......	......	S. 1.	1.0.	
Jan. 19,	7 56 A. M.	....	27.004	22.5	22.5	......	......	23.0	23.0	24.0	23.0	......	......	S. 1.	1 0.	
	10 16	....	27.022	27.0	27.8	......	......	28.0	27.0	28.0	27.0	......	......	S. 1.	1.0.	
	11 40	....	27.058	33.5	34.0	......	......	36.0	34.5	37.0	36.0	......	......	S. 1.	1.0.	Snowing.
	2 00 P. M.	....	27.072	34.5	36.0	......	......	34.5	34.5	35.0	33.0	......	......	S. 1.	1 0.	Snowing.
	4 00	....	27.056	33.5	34.0	......	......	33.5	32.0	34.0	33.0	......	......	S. 1.	1.0.	
	6 17	....	27.072	32.5	33.0	......	......	34.0	30.0	33.0	32 5	......	......	....	1.0.	
Jan. 20,	7 12 A. M.	....	27.118	29.0	29.0	....	......	30.0	29.0	29.0	29.0	......	......	....	1 0.	
	9 20	....	27.214	31.5	32 2	......	......	33.5	35.5	33.0	32 0	......	......	....	0.7.	
	Noon.	....	27.224	41.0	42 0	......	....	42.0	40.5*	41.8	40.0	......	......	S.SW. 1.	1.0.	
	1 34 P. M.	....	27.212	39.0	40.5	......	......	39 5	37.0	41.0	37.8	......	.....	S.SW. 1.	1.0.	
	4 00	....	27.152	34.5	34.5	......	......	36.0	34 0	37.0	36.0	......	......	W. 1.	1.0.	
	6 43	....	27.156	33 2	33.0	......	......	34 8	34 0	35.5	35 0	......	......	N.NW. 4.	1.0.	
	8 57	....	27.196	32.5	33.0	......	......	32.8	32.0	33.0	32.5	......	......	N.NW. 1.	1.0.	Snowing.
Jan. 21,	7 30 A. M.	....	27.198	30.5	31.0	......	......	30.8	30.0	31.0	30.5	......	0.14	Calm.	1.0.	Snowing; 1¼ inch.
	10 00	....	27.164	35.2	36.0	......	......	37.0	37.8*	37.8	35.8	......	......	Calm.	1.0.	
	0 10 P. M.	....	27 152	39.0	40.0	......	......	40.0	38.0	39.0	39.0	......	......	Calm.	1.0.	
	2 00	....	27.138	39.8	40 8	......	......	40.8	38.0	41.8	39.5	......	......	Calm.	1.0.	
	4 00	....	27.058	35.0	35.0	......	......	35.0	33.5	36.5	35.0	......	......	S.SE. 1.	1.0.	
	6 30	....	27.000	31.8	32.9	......	......	32.0	30.8	33.2	31.5	......	......	Calm.	1.0.	
	9 08	....	26.976	31.4	31.5	......	......	32.0	30.5	32.5	32.0	......	......	W. 1.	1.0.	
Jan. 22,	6 10 A. M.	....	26.988	31.5	32.0	......	......	33.0	30.8	34.0	32.8	......	......	S.SW. 1.	1.0.	

	9 54	......	26.876	33.8	34.3	......	......	35.5	33.8	36.8	35.0	......	......	S.SW. 1.	1.0.	
	11 54	......	26.836	36.8	40.0	......	......	41.2	37.5	43.0	40.5	......	......	Calm.	1.0.	
	0 54 P. M.	......	26.806	40.5	42.0	......	......	42.8	38.5	45.4	42.5	......	......	Calm.	1.0.	
	2 30	......	26.796	41.5	42.0	......	......	45.0	37.5	47.5	46.0	......	......	N.NW. 1.	1.0.	
	4 10	......	26.778	38.5	38.6	......	......	42.5	38.8	44.0	43.5	......	......	N.NW. 1.	1.0.	
	6 10	......	26.750	33.0	33.0	......	......	34.5	31.0	35.5	34.5	......	......	W. 1.	1.0.	
	8 05	......	26.752	31.5	31.8	......	......	32.5	29.0	33.0	32.5	......	......	W. 1.	1.0.	Snowing.
Jan. 23,	8 20 A. M.	......	26.860	30.5	31.0	......	......	31.5	30.0	31.8	30.8	......	......	S.SW. 1.	1.0.	Snowing.
	10 25	......	26.912	32.5	33.0	......	......	34.0	29.8	35.0	33.0	......	......	......	1.0.	Snowing.
	0 27 P. M.	......	26.936	32.6	34.0	......	......	32.8	30.0	33.8	31.3	......	......	S.SW. 1.	1.0.	Snowing; 0.5 inch.
	2 10	......	26.988	33.0	33.0	......	......	31.5	29.5	32.5	30.8	......	0.05	S.SW. 1.	1.0.	
	4 20	......	27.018	26.6	29.8	......	......	30.0	29.0	30.8	29.8	......	......	S.SE. 2.	0.8.	
	8 47	......	27.180	28.5	28.5	......	......	29.0	29.0	22.8	22.0	......	......	S.SE. 2.	0.8.	
Jan. 24,	7 26 A. M.	......	27.406	21.8	22.0	......	......	21.8	21.0	21.8	20.8	......	......	Calm.	1.0.	
	10 03	......	27.464	32.0	32.8	......	......	33.8	32.8	41.8	35.4	......	......	S. 1.	0.5.	
	0 36 P. M.	......	27.474	38.5	40.0	......	......	36.2	31.2	39.0	34.5	......	......	S.SW. 1.	1.0.	
	2 05	......	37.458	38.0	39.0	......	......	35.5	32.0	37.8	35.0	......	......	S.SE. 1.	1.0.	
	4 00	......	27.456	34.0	34.0	......	......	33.0	28.0	34.5	32.8	......	......	N.NE. 1.	0.8.	
	6 52	......	27.446	21.0	20.5	......	......	23.0	20.5	23.5	22.5	......	......	Calm.	Clear.	
Jan. 25,	7 22 A. M.	......	27.512	12.0	11.0	......	......	12.0	11.0	12.0	11.5	......	......	Calm.	0.4.	
	10 37	......	27.562	28.5	30.0	......	......	27.2	26.8	30.0	24.0	......	......	S. 1.	0.3.	
	Noon.	......	27.552	34.8	36.0	......	......	32.0	31.0	36.5	30.0	......	......	W. 1.	0.3.	
	1 27 P. M.	......	27.550	35.0	36.5	......	......	31.5	30.0	36.5	31.8	......	......	W. 1.	Stra. 0.5.	
	2 22	......	27.542	33.8	34.0	......	......	32.0	29.6	40.5	34.0	......	......	W. 1.	Stra. 0.5.	
	3 33	......	27.556	32.0	32.8	......	......	29.0	27.0	31.5	29.0	......	......	Calm.	0.1.	
	4 52	......	27.552	22.8	22.0	......	......	21.8	20.8	23.5	21.8	......	......	N. 1.	0.1.	
	7 15	......	27.576	13.8	13.0	......	......	14.0	14.0	15.5	14.5	......	......	Calm.	Clear.	
Jan. 26,	8 48 A. M.	......	27.834	6.8	7.0	......	......	5.5	7.0	6.5	4.5	......	......	Calm.	0.3.	
	11 14	......	27.868	30.8	32.0	......	......	25.5	29.0	32.0	25.5	......	......	Calm.	0.3.	
	1 11 P. M.	......	27.830	30.5	31.0	......	......	31.5	30.0	45.0	36.0	......	......	Calm.	Clear.	
	2 00	......	27.894	37.8	40.0	......	......	30.5	29.8	34.5	29.8	......	......	S.SE. 1.	Clear.	
	4 20	......	27.800	27.5	26.8	......	......	24.8	23.5	26.5	24.5	......	......	Calm.	Clear.	
	6 40	......	27.786	13.8	13.5	......	......	14.3	14.5	15.5	14.5	......	......	Calm.	Clear.	
	8 45	......	27.752	9.8	9.0	......	......	10.0	10.5	10.5	9.8	......	......	N. 1.	Clear.	
Jan. 27,	8 11 A. M.	......	27.720	1.5	1.0	......	......	1.0	1.5	2.0	0.5	......	......	Calm.	0.3.	
	10 16	......	27.700	17.8	19.4	......	......	18.4	23.0?	27.0	19.0	......	......	Calm.	0.5.	
	0 03 P. M.	......	27.628	25.5	26.8	......	......	23.5	22.8	26.8	21.0	......	......	S.SW. 1.	1.0.	
	1 27	......	27.610	30.8	33.0	......	......	28.7	26.3	39.4	30.0	......	......	Calm.	0.7.	
	2 12	......	27.616	33.0	33.0	......	......	27.8	26.5	35.0	29.0	......	......	Calm.	0.5.	
	5 17	......	27.598	25.5	24.8	......	......	24.2	24.0	26.5	25.0	......	......	Calm.	0.4.	
	6 14	......	27.572	15.0	14.8	......	......	15.8	15.5	16.8	16.0	......	......	Calm.	Clear.	
	9 04	......	27.528	15.0	14.8	......	......	14.0	14.5	15.0	14.0	......	......	N. 1.	Clear.	
Jan. 28,	7 50 A. M.	......	27.456	1.5	0.8	......	......	1.0	1.8	2.0	1.0	......	......	SW. 1.	0.1.	
	9 15	......	27.462	17.0	20.0	......	......	12.5	16.5	19.5	9.5	......	......	W. 1.	Clear.	
	10 50	......	27.444	29.8	32.0	......	......	24.9	23.8	29.5	23.6	......	......	S. 1.	Clear.	
	1 05 P. M.	......	27.410	32.8	33.5	......	......	33.0	31.0	42.5	37.0	......	......	S. 1.	Cir. 0.1.	
	2 33	......	27.390	34.5	35.0	......	......	32.8	30.5	39.0	35.0	......	......	S. 1.	Cir. 0.1.	
	4 26	27.149	27.400	26.8	26.8	......	......	25.8	25.2	27.0	25.8	......	......	N. 1.	Clear.	
	6 00	27.140	27.398	21.8	21.8	......	......	20.8	20.5	21.0	20.8	......	......	N. 1.	Clear.	
	8 00	27.127	27.406	14.0	14.0	......	......	13.5	13.3	14.0	12.8	......	......	NE. 1.	Clear.	
Jan. 29,	7 23 A. M.	27.120	27.360	3.5	2.5	......	......	2.0	2.0	2.5	1.3	......	......	Calm.	Clear.	
	10 15	27.140	27.412	24.0	25.5	......	......	23.5	......	30.5	21.5	......	......	S.SE. 1.	Clear.	
	11 30	27.153	27.452	28.5	31.0	......	......	30.0	......	40.5	33.8	......	......	W. 1.	Cum. 0.2.	

Meteorological observations—Continued.

BITTER ROOT.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
					Dry.	Wet.	Dry.	Wet.							
1860 A. m.			*	*			*	*	*	*				*	
Jan. 29, 0 30 P. M.	27.150	27.440	33.7	35.0	......	......	36.5	......	56.5	37.5	......	......	S. 1.	Clear.	
2 00	27.128	27.423	45.5*	39.0	......	......	38.0	......	42.7	37.0	....	....	S.SW. 1.	Clear.	* Sun.
4 00	27.125	27.416	35.5	36.0	......	......	33.8	......	36.5	34.0	......	......	W. 1.	Clear.	
6 30	27.117	27.386	21.5	21.5	......	......	21.3	21.0	22.5	21.5	......	......	W. 1.	Clear.	
9 30	27.117	27.388	13.0	13.0	......	......	14.0	......	14.5	13.5	......	......	NW. 1.	Clear.	
Jan. 30, 6 00 A. M.	27.118	27.398	3.5	3.5	.....	....	4.5	......	4.7	4.5	......	......	Calm.	0.1.	
9 00	27.125	27.412	10.0	12.0	......	.....	12.8	......	17.5	10.7	......	......	S.SE. 1.	0.1.	
10 00	27.148	27.437	22.7	24.5	......	.....	22.5	......	34.0	20.7	......	......	S.SE. 2.	Cir. 0.9.	
11 00	27.155	27.440	30.0	31.4	......	......	30.5	......	42.3	28.5	......	......	S.SE. 2.	Cir. 0.2.	
Noon.	27.177	27.438	34.5	35.7	.....	......	36.0	36.0	52.5	35.3	......	......	S.SE. 2.	Cir. 0.2.	
2 15 P. M.	27.152	27.426	42.0	41.5	......	....	40.5	36.7	60.5	44.7	......	.....	SW. 1.	Cir. 0.2.	
4 00	27.155	27.422	35.3	35.5	......	....	35.0	31.3	39.0	35.5	.....	......	NW. 1.	Clear.	
5 50	27.154	27.420	25.7	26.0	.....	......	25.5	25.0	26.0	25.5	......	......	NW. 1.	Clear.	
8 05	27.170	27.422	19.0	19.5	......	......	19.3	19.0	19.5	18.5	......	......	Calm.	Clear.	
Jan. 31, 7 30 A. M.	27.238	27.530	1.7	1.5	.....	.....	2.5	2.5	9.5	1.5	......	......	Calm.	Clear.	
10 00	27.275	27.586	21.0	24.0	......	.....	18.5	....	30.0	18.5	.....	......	Calm.	Clear.	
0 30 P. M.	27.310	27.602	35.5	36.0	......	.....	35.3	32.0	48.0	37.0	......	......	SE. 2.	Clear.	
2 30	27.302	27.592	37.5	36.7	......	......	36.5	32.0	64.0	49.3	......	......	NE. 1.	Clear.	
5 30	27.295	27.572	23.5	23.5	......	......	25.0	24.0	25.7	24.5	......	....	NE. 1.	Clear.	
8 00	27.295	27.570	17.0	17.0	......	.....	16.5	16.3	17.0	16.0	.....	......	Calm.	Clear.	
10 00	27.297	27.572	11.3	12.0	......	......	12.0	......	12.5	11.7	......	......	Calm.	Clear.	
Feb. 1, 7 45 A. M.	27.297	27.580	5.3	5.0	......	.....	5.5	5.0	6.0	5.5	......	......	NW. 1.	Cum. 0.2.	
10 30	27.333	27.648	29.0	33.0	......	.....	29.0	......	34.0	26.5	......	.....	SE. 2.	Cir. 0.2.	
Noon.	27.342	27.640	37.8	39.0	......	.....	38.5	34.3	49.7	38.7	......	....	Calm.	Cir. 0.1.	
2 00 P. M.	27.305	27.586	46.0	49.0	......	.....	44.0	38.0	66.5	48.7	......	......	SW. 1.	Cir. 0.1.	
4 10	27.275	27.546	38.5	38.7	......	......	39.0	36.5	42.3	39.7	......	.....	NW. 1.	Cir. 0.6.	
7 15	27.235	27.493	26.3	27.0	......	......	26.5	......	27.0	26.5	....	......	Calm.	Overcast 1.0.	
9 00	27.230	27.500	26.8	27.5	......	......	26.0	.....	27.5	26.3	......	.....	S. 1.	Overcast 1.0.	
Feb. 2, 6 20 A. M.	27.242	27.500	19.0	19.5	......	......	19.5	.....	20.3	19.3	......	......	W. 1.	0.9.	
7 40	27.255	27.523	20.0	21.0	......	....	20.5	......	20.3	19.0	......	......	W.NW. 1.	Cum. 0.9.	
9 30	....	27.528	27.5	29.0	......	....	28.5	....	34.3	28.3	......	.....	SE. 1.	Cum. 0.5.	
11 00	....	27.532	35.0	36.2	......	......	35.5	34.7	42.9	37.5	......	......	S.SE. 1.	Overcast 1.0.	
1 00 P. M.	....	27.512	43.5	44.7	......	....	44.0	41.3	54.5	44.7	......	....	SW. 1.	Overcast 1.0.	
3 05	....	27.446	43.3	44.3	......	....	43.0	36.0	47.5	45.0	......	.....	Calm.	Overcast 1.0.	
35	....	27.388	36.5	37.0	......	.....	37.5	33.0	39.4	38.5	......	.....	Calm.	Overcast 1.0.	

	7 15	....	27.274	[illegible]	[illegible]	......	......	[illegible]	[illegible]	[illegible]	[illegible]	......	......	W.SW. 1.	Overcast 1.0.	Snowing.
	10 00	....	27.306	31.0	31.5	......	......	31.0	[illegible]	31.3	[illegible]	......	0.11	W.SW. 1.	Overcast 1.0.	Snow, 1.0 inch.
Feb. 3,	7 25 A. M.	....	27.382	29.0	29.5	......	......	30.0	29.5	30.3	29.5	......	......	W. 1.	Overcast 1.0.	
	10 00	....	27.402	33.0	35.0	......	......	35.5	34.5	35.5	34.3	......	......	W. 1.	Str. 1.0.	
	1 30 P. M.	....	27.394	38.5	40.0	......	......	30.0	36.5	39.0	36.0	......	......	W. 2.	Str. 1.0.	Snowing.
	4 00	....	27.388	32.7	34.0	......	......	33.0	32.3	33.0	31.5	......	0.05	W. 2.	Str. 1.0.	Snowing, 0.5 inch.
	7 00	....	27.376	30.0	30.5	......	......	30.5	30.0	30.5	29.5	......	......	NE 1.	Str. 1.0.	
	9 40	....	27.378	29.7	30.5	......	......	28.5	28.2	28.7	28.2	......	......	NW. 2.	Str. 1.0.	
Feb. 4,	8 10 A. M.	....	27.554	25.5	26.0	......	......	26.5	26.0	26.7	25.0	......	......	Calm.	Str. 1.0.	
	10 10	....	27.567	32.0	33.0	......	......	33.2	32.2	36.0	32.0	......	......	Calm.	Str. 1.0.	
	Noon.	....	27.566	37.7	39.0	......	......	39.0	36.0	50.0	44.0	......	......	Calm.	0.9.	
	0 30 P. M.	....	27.565	40.5	41.0	......	......	42.0	39.0	69.0	51.0	......	......	SE. 1.	0.5.	
	2 00	....	27.563	44.5*	45.0*	......	......	41.7	37.5	48.7	41.7	......	......	SE. 1.	0.7.	* Sun.
	4 00	....	27.564	38.2	38.0	......	......	39.0	34.0	41.0	38.0	......	......	NW. 2.	1.0.	
	5 20	....	27.556	34.5	34.5	......	......	34.5	32.5	35.5	34.5	......	......	Calm.	1.0.	
	7 20	....	27.554	32.0	33.0	......	......	33.0	31.0	33.0	32.0	......	......	NW. 1.	1.0.	
	9 30	....	27.553	31.3	32.0	......	......	32.0	31.0	32.0	31.0	......	......	Calm.	1.0.	
	10 30	....	27.562	31.2	32.3	......	......	31.8	30.5	31.8	30.8	......	......	W. 2.	1.0.	
Feb. 5,	8 30 A. M.	....	27.556	30.5	32.0	......	......	32.0	31.0	32.0	30.3	......	......	Calm.	1.0.	
	10 00	....	27.558	35.0	36.2	......	......	35.5	34.5	36.3	33.7	......	......	Calm.	1.0.	
	Noon.	....	27.553	43.5	44.0	......	......	44.5	42.5	54.0	43.0	......	......	W. 1.	0.9.	
	2 00 P. M.	....	27.518	47.3	46.5	......	......	46.5	39.5	54.7	47.5	......	......	NW. 2.	0.9.	
	4 00	....	27.501	43.0	43.5	......	......	43.3	38.5	44.8	43.2	......	......	NW. 2.	0.9.	
	6 00	....	27.494	37.0	37.5	......	......	36.5	34.3	37.0	36.0	......	0.00	W.NW. 2.	0.9.	Rainy.
	9 00	....	27.493	31.5	33.0	......	......	31.3	......	31.5	31.0	......	......	W. 3.	0.4.	
Feb. 6,	Midnight.	....	27.486	27.0	27.7	......	......	26.5	25.3	27.0	26.0	......	......	W.NW. 2.	0.7.	
	1 00 A. M.	....	27.484	28.5	29.0	......	......	28.5	28.3	28.5	27.7	......	......	W. 2.	0.9.	
	8 40	....	27.436	25.7	26.5	......	......	26.0	......	27.3	25.0	......	......	SE 2.	0.2.	
	11 00	....	27.427	37.7	39.0	......	......	37.5	36.5	45.3	39.5	......	......	SE 1.	0.5.	
	Noon.	....	27.399	40.7	41.5	......	......	41.5	39.5	59.5	45.5	......	......	SE. 1.	0.4.	
	1 00 P. M.	....	27.365	43.0	44.0	......	......	44.2	38.2	64.8	49.7	......	......	SE 1.	0.3.	
	2 00	....	27.312	54.5	50.3*	......	......	46.3	41.3	61.0	49.5	......	......	Calm.	0.3.	* Sun.
	4 15	....	27.213	41.0	41.5	......	......	41.0	37.5	45.3	41.7	......	......	S. 1.	0.5.	
	6 00	....	27.176	30.7	31.3	......	......	31.0	29.5	30.0	29.0	......	......	S. 1.	Clear.	Moon eclipsed.
	7 00	....	27.172	28.0	29.0	......	......	28.5	27.3	28.5	27.5	......	......	Calm.	Cir. 0.2.	
	8 00	....	27.148	26.0	26.3	......	......	25.5	25.0	26.5	25.5	......	......	W. 1.	Cir. 0.3.	
	10 30	....	27.124	23.0	23.5	......	......	23.0	22.5	23.5	23.0	......	......	W. 1.	Cir. 0.2.	
Feb. 7,	Midnight.	....	27.106	23.0	24.0	......	......	23.0	23.0	23.5	23.0	......	......	W. 2.	Cir. 0.4.	
	1 00 A. M.	....	27.110	23.0	24.0	......	......	23.5	23.5	23.5	23.0	......	......	W. 3.	Cir. 0.6.	
	7 15	....	27.036	29.0	30.0	......	......	29.5	......	30.0	29.2	......	......	W. 2.	Str. 1.0.	Snowing.
	9 00	....	27.040	32.7	33.5	......	......	32.5	31.3	32.0	30.5	......	......	Calm.	Str. 1.0.	Snowing.
	10 45	....	27.036	33.5	35.2	......	......	34.5	34.0	36.0	34.0	......	0.02	NW. 1.	Str. 1.0.	Snow, 0.2 inch.
	1 30 P. M.	....	27.026	40.5	41.0	......	......	42.0	36.0	44.0	41.5	......	......	W. 3.	Str. 1.0.	
	4 15	....	27.020	39.7	40.8	......	......	40.5	36.0	41.5	40.5	......	......	W. 3.	Nimb. 1.0.	
	7 00	....	26.924	36.0	36.2	......	......	37.5	35.3	38.0	37.0	......	......	W. 1.	Nimb. 1.0.	Rainy.
	9 45	....	26.916	35.0	35.5	......	......	36.3	35.0	36.5	36.0	......	0.16	W. 2.	Nimb. 1.0.	Snowing, 1.5 inch.
Feb. 8,	7 30 A. M.	....	27.162	28.0	28.5	......	......	26.5	26.0	27.0	26.0	......	......	NW. 3.	0.5.	
	9 00	....	27.184	28.0	28.0	......	......	27.5	27.0	28.2	26.5	......	......	W. 2.	0.5.	
	11 00	....	27.264	30.7	31.3	......	......	30.5	29.5	35.2	30.5	......	......	W. 2.	0.9.	
	1 00 P. M.	....	27.265	35.0	35.0	......	......	37.5	32.0	42.0	39.0	......	......	NW. 3.	0.6.	Bitter Root river very low.
	2 00	....	27.266	38.0	36.7	......	......	36.5	32.0	50.0	36.5	......	......	NW. 4.	0.4.	
	5 00	....	27.274	29.0	29.0	......	......	28.5	25.5	29.4	28.0	......	......	NW. 2.	0.7.	
	6 30	....	27.260	24.5	24.0	......	......	23.2	22.0	23.3	22.0	......	......	NW. 3.	Clear.	

Meteorological observations—Continued.

BITTER ROOT.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
					Dry.	Wet.	Dry.	Wet.							
1860. h. m.			°	°			°	°	°	°					
Feb. 8, 9 40 P. M.	....	27.959	23.0	23.0	......	......	20.5	20.0	20.6	19.5	......	......	NW. 4.	0.5.	
Feb. 9, 2 00 A. M	....	27.250	....	.....	......	......	19.5	19.0	19.5	18.5	......	0.01	Calm.	1.0.	Snowing; 0.1.
7 00	....	27.173	17.0	17.0	......	......	17.0	16.0	17.0	16.0	......	....	Calm.	1.0.	
9 20	....	27.132	25.0	27.0	......	......	23.5	22.0	24.2	20.0	......	......	Calm.	1.0.	
0 20 P. M.	....	27.010	33.5	36.5	......	......	31.8	29.0	35.0	29.0	......	......	Calm.	1.0.	
2 15	....	26.968	33.5	34.5	......	......	32.7	29.7	33.0	31.5	......	......	W. 1.	1.0.	
4 00	....	26.974	32.0	32.6	......	......	31.5	31.3	31.5	29.5	......	......	S.SE. 2.	1.0.	Snowing.
7 30	....	26.953	31.0	33.5	......	......	31.0	30.0	31.0	30.5	......	......	S.SE. 1.	0.5.	Snowing.
9 00	....	26.955	29.0	29.5	......	......	31.3	30.0	32.0	31.5	......	0.05	NW. 3.	0.4.	Snowing; 0.5 inch.
Feb. 10, 4 00 A. M.	....	27.088	31.0	33.5	......	......	30.5	30.3	31.0	30.0	......	......	N.NE. 2.	1.0.	
7 15	....	27.127	24.5	25.0	......	......	25.0	24.5	26.0	25.5	......	......	W. 3.	0.5.	
8 45	....	27.172	29.5	32.0	......	......	29.7	29.3	32.6	29.7	....	......	W. 2.	0.6.	
11 30	....	27.188	43.3	46.2	......	......	43.2	40.0	48.5	40.7	......	......	W.SW. 2.	0.9.	Snowing.
1 00 P. M.	....	27.190	42.7	43.6	......	......	43.0	36.8	44.2	41.7	......	0.01	W. 3.	1.0.	Snowing; 0.1 inch.
3 00	....	27.179	42.0	42.5	......	......	42.0	37.3	43.2	41.6	......	......	W. 4.	0.9.	
4 30	....	27.184	38.8	40.0	......	......	39.0	35.5	40.5	39.5	......	......	W.SW. 2.	1.0.	
10 00	....	27.166	34.0	36.2	......	......	33.0	31.5	33.0	32.0	......	......	W. 1.	1.0.	
Feb. 11, 7 30 A. M.	....	27.096	33.5	34.5	......	......	32.5	32.0	32.7	31.7	......	......	W. 1.	1.0.	Snowing.
9 00	....	27.092	34.0	35.0	......	......	35.0	35.0	35.0	33.5	......	0.10	W. 1.	1.0.	Snowing; 1 inch.
0 30 P. M.	....	27.086	42.0	43.0	......	......	39.3	39.3	39.3	38.7	......	0.06	Calm.	1.0.	Rain.
3 00	....	27.024	41.0	42.7	......	......	40.5	40.0	40.5	39.0	......	......	Calm.	1.0.	Fog; rainy.
6 00	....	27.012	34.3	35.0	......	......	33.7	33.5	39.5	33.7	......	......	W. 1.	1.0.	
Feb. 12, 8 30 A. M.	....	27.022	33.7	35.0	......	......	34.0	34.0	36.3	32.0	......	0.16	W. 2.	0.8.	Snow; 1.5 inch.
10 00	....	27.034	46.0*	44.0	......	......	43.5	46.0*	49.0	41.0	......	......	W.SW. 2.	0.8.	*Sun.
11 00	....	27.035	45.0	44.4	......	......	42.7	40.0	55.0	49.5	......	......	W. 3.	0.8.	
Noon.	....	27.032	39.0	39.0	......	......	38.5	36.0	39.0	36.0	......	0.01	W. 4.	0.8.	Snow; 0.1 inch.
1 40 P. M.	....	27.025	41.3	42.0	......	....	42.3	38.2	55.0	45.0	......	......	W.SW. 4.	0.3.	
4 00	....	27.075	40.3	42.5	......	......	41.2	37.3	52.0	45.0	......	......	W.SW. 2.	0.6.	
5 30	....	27.084	33.7	34.0	......	......	34.7	32.5	55.5	34.5	......	......	W. 1.	1.0.	
9 00	....	27.062	30.5	29.7	......	......	30.5	29.5	30.5	29.7	......	......	W. 1.	0.1.	
Feb. 13, 8 00 A. M.	....	27.160	25.5	27.0	......	......	23.5	23.5	24.5	22.7	......	......	Calm.	1.0.	
9 00	....	27.162	33.5	36.0	......	......	31.5	31.0	49.2	27.5	......	......	Calm.	Cir. 0.5.	
10 00	....	27.173	36.5	36.2	......	......	34.0	33.3	44.7	38.3	......	......	W. 1.	Cir. 0.6.	
11 00	....	27.174	41.3	44.0	......	......	36.7	37.0	60.0	41.5	......	......	NW. 1.	Cir. 0.3.	

	Noon.	......	[illegible]	41.7	42.0	......	......	[illegible]	[illegible]	[illegible]	41.0	......	......	[illegible]	Cir. 0.1.	
	2 00 P. M.	......	[illegible]	[illegible]	47.0	......	......	[illegible]	37.5	[illegible]	[illegible]	......	......	NW. 1.	Cum. 0.1.	
	3 00	......	27.155	43.5	46.0	......	......	41.0	38.5	45.9	41.5	......	......	NW. 1.	Cum 0.2.	
	4 30	......	27.147	37.7	38.5	......	......	38.5	34.0	46.0	40.5	......	......	NW. 1.	Cum. 0.1.	
	6 00	......	27.138	27.0	27.3	......	......	27.0	26.0	28.0	27.0	......	......	Calm.	Clear.	Zodaical light.
	8 00	......	27.138	21.7	22.0	......	......	22.5	22.0	23.5	22.5	......	......	Calm.	Clear.	
	10 00	......	27.148	21.7	22.0	......	......	19.5	19.5	20.0	19.5	......	......	Calm.	Clear.	
Feb. 14,	8 30 A. M.	......	27.264	26.0	28.0	......	......	24.5	23.3	24.0	22.5	......	......	NW. 1.	1.0.	
	10 00	......	27.271	28.7	30.5	......	......	29.0	27.5	30.0	28.0	......	......	SW. 2.	0.9.	Snowing.
	Noon.	......	27.300	43.5	46.0	......	......	43.0	36.5	57.0	44.7	......	......	W. 3.	0.6.	
	2 00 P. M.	......	27.300	43.0	44.5	......	......	42.2	36.5	47.5	41.7	......	......	W. 4.	0.7.	
	4 20	......	27.307	37.5	38.0	......	......	36.7	31.7	42.0	39.0	......	......	W. 3.	0.8.	
	6 15	......	27.290	31.0	31.5	......	......	31.0	29.0	33.2	31.5	......	......	W. 1.	1.0.	
	7 45	......	27.292	31.5	33.5	......	......	30.5	29.5	31.5	30.5	......	......	......	......	
Feb. 15,	7 00 A. M.	......	27.305	30.7	31.5	......	......	30.3	29.8	31.0	30.0	......	......	W. 1.	1.0.	
	9 15	......	27.284	37.0	38.0	......	......	39.4	34.5	40.5	39.0	......	......	W. 1.	1.0.	
	11 00	......	27.302	40.8	41.8	......	......	41.5	37.5	43.3	41.0	......	......	W. 1.	1.0.	
	1 15 P. M.	......	27.300	45.3	45.3	......	......	45.5	38.4	49.0	44.6	......	......	W. 1.	1.0.	
	2 35	......	27.308	45.5	45.5	......	......	44.3	37.3	47.8	44.8	......	......	W. 1.	1.0.	
	4 26	......	27.282	41.5	42.0	......	......	41.9	35.6	44.0	43.0	......	......	W. 1.	1.0.	
	6 10	......	27.262	35.0	35.8	......	......	36.5	32.5	37.3	37.0	......	......	W. 1.	0.6.	
	8 20	......	27.244	30.5	31.0	......	......	31.5	31.2	31.5	31.0	......	......	W. 1.	1.0.	
Feb. 16,	7 15 A. M.	......	27.110	33.5	35.0	......	......	32.5	32.2	33.0	32.0	...	....	W. 1.	1.0.	Rainy.
	9 00	......	27.124	36.0	37.0	......	......	35.2	35.2	36.5	34.6	......	0.05	W. 1.	1.0.	Rainy.
	11 00	......	27.140	43.0	44.8	......	......	41.2	41.5	44.0	40.0	......	......	W. 1.	1.0.	
	1 10 P. M.	......	27.134	46.5	48.0	......	......	47.0	43.0	51.5	46.0	......	......	W. 1.	0.8.	
	2 25	......	27.114	46.7	46.8	......	......	47.5	43.5	50.6	48.0	......	......	W. 1.	0.8.	
	5 15	......	27.136	40.5	42.0	......	......	42.0	39.0	43.0	42.0	......	......	W. 1.	0.9.	Average depth of snow on the ground between observatory and side hills 11¼ in.
	7 00	......	27.100	34.0	34.0	......	......	35.0	33.0	35.2	34.8	......	......	Calm.	Clear.	
	8 30	......	27.126	33.5	34.0	......	......	34.0	32.5	34.0	33.5	......	......	Calm.	0.7.	
Feb. 17,	7 00 A. M.	......	27.070	32.7	33.5	......	......	32.2	31.3	32.3	31.8	......	......	W. 1.	0.9.	
	9 00	......	27.050	36.0	38.0	......	......	37.0	36.5	39.0	35.6	......	......	W. 1.	1.0.	
	10 40	......	27.040	42.0	43.0	......	......	42.5	40.5	43.5	40.5	35.0	......	W. 1.	0.9.	
	1 05 P. M.	......	27.029	49.7	51.0	......	......	49.5	45.8	54.8	48.0	......	......	W. 1.	1.0.	
	3 15	......	27.027	51.5	53.0	......	......	51.0	45.5	52.5	49.5	......	......	W.NW. 2.	0.9.	Rain.
	5 07	......	27.012	43.0	43.5	......	......	43.5	40.0	44.5	43.0	......	......	W. 1.	0.8.	
	7 00	......	26.942	36.2	36.0	......	......	36.5	34.5	36.8	36.0	......	......	Calm.	1.0.	
	9 25	......	26.956	33.0	32.8	......	......	31.5	30.5	31.8	31.0	......	......	Calm.	0.2.	
Feb. 18,	Midnight	......	26.932	30.0	30.0	......	......	28.5	28.0	29.0	28.5	......	......	S. 1.	0.5.	
	1 00 A. M.	......	26.948	27.0	28.3	......	......	28.0	27.0	28.3	27.5	......	......	E. 1.	0.5.	
	7 00	......	26.967	33.5	35.0	......	......	32.0	31.5	32.5	31.5	......	......	Calm.	1.0.	Rainy.
	8 33	......	26.960	34.0	35.4	......	......	34.5	34.5	35.0	34.5	......	......	Calm.	Nimb. 1.0.	Rainy.
	11 03	......	27.028	44.5	45.0	......	......	43.0	39.8	45.0	41.5	......	......	W. 1.	Nimb. 1.0.	Rainy.
	1 00 P. M.	......	27.040	42.0	41.5	......	......	40.6	39.0	41.5	38.5	......	......	W. 1.	0.9.	Rainy.
	2 10	......	27.034	41.9	42.2	......	......	42.4	39.2	43.5	40.6	......	......	W. 1.	1.0.	Rainy.
	4 00	......	27.036	39.5	40.5	......	......	38.0	37.8	38.8	37.0	......	......	W. 1.	0.8.	Rainy.
	6 34	......	27.132	34.0	33.8	......	......	33.8	33.5	33.8	33.5	......	......	W. 1.	0.9.	Rainy.
	8 10	......	27.140	32.3	33.0	......	......	32.0	32.0	32.5	32.0	......	0 10	W. 1.	0.9.	Rainy
Feb. 19,	7 00 A. M.	......	27.398	29.3	30.0	......	......	29.0	28.5	29.3	28.5	......	......	W. 2.	0.5.	
	9 00	......	27.392	32.5	33.5	......	......	34.2	31.5	37.0	33.8	......	......	W. 1.	1.0.	
	11 00	......	27.394	40.3	40.0	......	......	40.8	37.5	46.0	39.8	......	......	W. 1.	1.0.	
	Noon.	......	37.392	42.5	41.8	......	......	43.8	39.5	58.0	45.5	......	......	W. 1.	1.0.	
	2 05 P. M.	......	27.340	41.0	42.5	......	......	42.0	36.0	44.0	41.0	......	......	W. 1.	1.0.	

Meteorological observations—Continued.

BITTER ROOT.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Rain.
					Dry.	Wet.	Dry.	Wet.							
1860. h. m.			°	°	°	°	°	°	°	°	°				
Fed. 19, 4 00 P. M.	....	27.338	39.0	39.8	......	......	40.0	35.0	41.2	39.7	......	......	W. 1.	1.0.	
6 24	....	27.308	31.5	31.8	......	......	32.8	29.0	32.5	32.0	......	......	W. 1.	0.3.	
8 00	....	27.274	28 0	28 5	......	......	29 0	28.0	29.8	28.8	......	......	W. 1.	0.2.	
10 15	....	27.264	28.0	28.5	......	......	27.3	26 5	28.0	27.0	......	......	W. 1.	0.1.	Shooting stars.
Feb. 20, 7 10 A. M.	....	26.852	28.5	30.0	......	......	27.5	27.0	27.7	26.7	......	......	W. 1.	1 0.	
9 16	....	26.748	30 8	31 2	......	......	31.0	30.5	31.2	30.0	......	......	W. 1.	1.0.	
11 20	....	26.748	40.0	42.0	......	......	39.8	38.5	39.0	36.5	......	......	W. 1.	1.0.	
1 20 P. M.	....	26.772	38.8	40.0	......	......	39.5	36.5	37.0	38.5	......	......	W. 1.	1.0.	Snowing.
3 24	....	26.812	35.2	35.5	......	......	34.5	32 5	35.0	33.2	......	......	W. 1.	1.0.	Snowing.
5 30	....	26.846	30.8	31 0	......	......	29.5	29.0	30.0	28 5	......	0.13	N. 1.	1.0.	Snowing; 1.4 inch.
8 54	....	26.892	28.5	29.0	......	......	27.0	26.8	27.8	27.0	......	......	Calm.	0.2.	
Feb. 21, 7 00 A. M.	....	27.170	29.0	29.8	......	......	27.0	26.5	27.5	26.5	......	......	W. 1.	1.0.	
8 53	....	27.228	31.0	32.0	......	......	30.5	30.0	31.0	29.0	......	......	Calm.	1.0.	
10 48	....	27.290	33.0	33.5	......	......	33.0	32.0	33.0	30.0	......	......	Calm.	1.0.	Snowing.
1 10 P. M.	....	27.336	37.8	39.0	......	......	36.2	34.0	38.8	34.0	......	......	S. 1.	1.0.	
3 37	....	27.396	38.5	38.0	......	......	38.5	32.5	44.0	36.8	......	......	NE. 1.	0.6.	
6 45	....	27.416	23.0	23.0	......	......	21 5	21.0	22.5	21.6	......	......	Calm.	0.1.	
9 22	....	27 486	17.5	17 5	......	......	16.5	16.0	18.0	17.0	......	......	Calm.	Clear.	
11 32	....	27.468	14 5	14.5	......	......	13.0	13 0	14.0	14.0	......	......	Calm.	Clear.	
Feb. 22, 7 15 A. M.	....	27.655	13.5	14.0	......	......	12.0	11.5	11 5	10.5	......	......	W. 1.	0.3.	
8 50	....	27.690	21.8	23.0	......	......	21.5	23 5*	26.0	19.5	......	......	W. 1.	0.6.	*Sun.
11 17	....	27.692	36.0	34.0	......	......	32.0	33.5*	47.0	33.5	......	......	W. 2.	0.4.	
1 00 P. M.	....	27.660	36.5	36.5	......	......	38.8	35.0	55.2	39.0	......	......	NW. 1.	0.4.	
2 12	....	27.662	39.2	39.4	......	......	39.0	38.5	43 0	38 8	......	......	NW. 1.	0.5.	
4 00	....	27.656	38.5	38.0	......	......	38.5	32.0	50.0	40 8	......	......	NW. 1.	0.6.	
7 58	....	27.674	28.8	29.0	......	......	27.5	26.8	28 5	27.5	......	......	W. 1.	Clear.	
10 20	....	27.706	21.5	21.0	......	......	20.3	......	21.0	20.3	......	......	NW. 1.	Clear.	
11 45	....	27.728	18.0	18 5	......	......	18.0	......	18.8	18.0	......	......	NW. 1.	Clear.	
Feb. 23, 6 50 A. M.	....	27.824	16.5	17.5	......	......	15.0	......	16.0	14.5	......	......	W. 1.	1.0.	
8 20	....	27.890	17.5	18.8	......	......	16.5	16.5	17.0	15.0	......	......	W. 1.	1.0.	
10 04	....	27.882	31.0	32.0	......	......	31.5	31.8	42.8	30.8	......	......	SW. 1.	Clear.	
0 04 P. M.	....	27.836	40.4	41.0	......	......	39.5	35.0	54.5	40.5	......	......	SW. 1.	Clear.	
2 00	....	27.804	43.0	44.0	......	......	42.0	38.0	50.6	44.5	......	......	SW. 1.	Clear.	
3 45	....	27.788	44.5	46.0	......	......	41.3	36.8	49.0	43.0	......	......	SW. 1.	0.1.	

	8 00 P. M.	......	[illegible]	[illegible]	[illegible]	......	......	22.5	[illegible]	[illegible]	21.0	......	......	W. 1.	[illegible]	
	8 40	......	[illegible]	25.0	24.8	......	......	[illegible]	......	[illegible]	[illegible]	......	......	NW. 1.	Clear.	
	11 00	......	27.764	20.0	20.0	......	......	19.0	......	20.0	19.9	......	......	W.NW. 1.	Clear.	
Feb. 24,	6 45 A. M.	......	27.782	13.0	13.0	......	......	14.0	......	14.5	13.5	......	......	Calm.	0.4.	
	9 00	......	27.808	27.8	29.5	......	......	27.5	......	35.0	25.5	......	......	W. 1.	0.4.	
	10 00	......	27.812	33.0	33.8	......	......	33.0	......	48.5	32.8	......	......	W. 1.	0.3.	
	0 05 P. M.	......	27.780	43.5	45.0	......	......	43.5	39.8	61.0	45.0	......	......	S. 1.	0.3.	
	1 20	......	27.740	46.4	48.0	......	......	49.0	41.0	67.3	53.0	......	......	S. 1.	0.1.	Max. black 73 deg.
	2 00	......	27.750	48.5	51.0	......	......	48.5	41.5	61.0	52.0	......	......	S. 1.	Clear.	
	4 30	......	27.674	46.5	49.0	......	......	43.0	38.5	47.0	45.0	......	......	S. 1.	0.2.	
	6 00	......	27.674	32.8	33.5	......	......	31.5	29.0	33.0	32.0	......	......	Calm.	0.1.	
	8 30	......	27.644	26.0	26.5	......	......	23.8	22.7	24.8	23.8	......	......	Calm.	Clear.	
	10 00	......	27.636	21.8	22.0	......	......	21.0	......	22.0	21.0	......	......	NW. 1.	Clear.	
	11 40	......	27.649	19.0	18.7	......	......	19.2	......	4.5	18.7	......	......	W. 1.	Clear.	
Feb. 25,	6 30 A. M.	......	27.554	20.5	21.0	......	......	21.0	......	20.5	19.7	......	......	S. 1.	0.8.	Clear till 4 a. m.
	8 13	......	27.524	25.5	25.5	......	......	26.0	24.5	25.0	23.5	......	......	W. 1.	1.0.	
	10 00	......	27.518	32.4	33.0	......	......	33.5	32.0	34.0	31.5	......	......	W. 1.	1.0.	
	Noon.	......	27.494	45.5	46.5	......	......	46.0	40.5	52.5	46.0	......	......	W. 2.	1.0.	
	1 36 P. M.	......	27.474	46.0	46.0	......	......	46.5	42.0	49.0	46.5	......	......	W. 4.	1.0.	
	3 15	......	27.467	43.0	44.0	......	......	44.0	37.0	45.4	43.8	......	......	W.NW. 3.	1.0.	
	5 04	......	27.430	40.5	41.0	......	......	40.5	37.5	41.5	41.0	......	......	W. 3.	1.0.	
	7 40	......	27.417	34.3	35.5	......	......	34.0	33.3	35.0	34.3	......	......	Calm.	1.0.	
	9 25	......	27.408	33.5	34.5	......	......	33.5	33.0	34.5	33.5	......	......	S. 2.	0.9.	
Feb. 26,	6 30 A. M.	......	27.415	32.0	33.0	......	......	32.7	......	34.0	33.3	......	......	W.NW. 2.	1.0.	Raining and snowing.
	8 30	......	27.419	33.5	36.0	......	......	35.5	......	36.5	34.5	......	......	NW. 1.	1.0.	
	10 00	......	27.449	36.0	36.5	......	......	37.0	31.0	38.0	36.0	......	......	NW. 2.	0.9.	
	Noon.	......	27.450	43.0	43.3	......	......	42.0	35.8	48.5	41.0	......	......	NW. 3.	0.7.	
	2 00 P. M.	......	27.448	40.3	40.0	......	......	40.3	34.0	41.0	39.3	......	......	NW. 3.	1.0.	Snowing.
	4 00	......	27.452	37.7	38.0	......	......	38.0	31.0	38.7	38.0	......	......	W. 2.	1.0.	
	6 20	......	27.445	35.5	36.0	......	......	35.7	31.0	36.7	36.0	......	......	W. 2.	1.0.	
	8 50	......	27.442	31.7	32.5	......	......	32.7	......	33.0	32.5	......	......	W. 1.	1.0.	
Feb. 27,	6 45 A. M.	......	27.515	17.7	18.5	......	......	17.2	......	17.5	16.7	......	......	W. 1.	0.4.	
	9 00	......	27.516	31.0	34.2	......	......	33.2	......	46.0	34.5	......	......	W. 2.	0.3.	
	10 30	......	27.518	39.5	41.0	......	......	40.0	36.0	54.0	40.5	......	......	SW. 1.	0.1.	
	Noon.	......	27.515	45.0	45.7	......	......	44.3	38.3	58.8	44.3	......	......	S. 2.	0.1.	
	1 00 P. M.	......	27.462	44.5	45.0	......	......	47.4	39.5	66.0	51.5	......	......	SW. 2.	0.1.	
	3 00	......	27.452	47.4	49.2	......	......	45.0	37.5	46.3	45.0	......	......	SW. 3.	Clear.	
	5 00	......	27.440	41.0	42.5	......	......	40.5	36.0	42.5	41.0	......	......	SW. 1.	Cir. 0.2.	
	7 00	......	27.380	29.0	29.7	......	......	28.0	26.0	29.0	28.0	......	......	W. 2.	0.1.	
	9 15	......	27.348	24.5	25.0	......	......	23.0	22.5	24.0	23.5	......	......	SW. 1.	0.2.	
Feb. 28,	1 15 A. M.	......	27.282	20.3	21.3	......	......	20.0	19.5	20.5	19.8	......	......	S. 1.	Clear.	
	6 45	......	27.203	21.0	21.5	......	......	20.0	......	20.3	19.5	......	......	NW. 2.	0.2.	
	9 00	......	27.146	31.0	33.0	......	......	32.5	......	42.5	32.0	......	......	W.NW. 1.	0.4.	
	11 00	......	27.156	38.7	41.5	......	......	39.0	35.0	43.2	39.3	......	......	NW. 2.	0.9.	
	0 40 P. M.	......	27.154	42.5	44.7	......	......	44.0	37.3	46.0	43.0	......	......	NW. 3.	1.0.	
	3 00	......	27.097	42.3	43.0	......	......	42.3	36.3	43.2	42.2	......	......	W. 2.	1.0.	
	5 00	......	27.095	36.8	37.5	......	......	36.3	35.3	37.5	36.0	......	......	W.SW. 1.	1.0.	Raining.
Feb. 29,	7 00 A. M.	......	26.967	32.0	33.5	......	......	31.5	31.0	31.7	31.0	......	......	Calm.	1.0.	Snow.
	9 30	......	26.952	33.5	34.6	......	......	33.0	32.5	34.5	32.0	......	......	Calm.	1.0.	Snow.
	0 31 P. M.	......	26.842	36.0	37.0	......	......	32.0	37.8	36.0	33.5	......	......	Calm.	1.0.	Snow.
	2 41	......	26.880	37.0	38.0	......	......	37.0	36.0	36.0	34.0	......	......	......	......	Snow.
	4 31	......	26.910	35.0	35.8	......	......	34.5	33.8	34.0	33.0	......	......	SW. 1.	1.0.	
	8 00	......	26.991	28.0	28.5	......	......	28.0	27.8	28.5	28.0	......	0.17	Calm.	1.0.	Snow.

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE.		OUTSIDE.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
					Dry.	Wet.	Dry.	Wet.							
1860. A. m.			°	°	°	°	°	°	°	°	°				
March 1, 7 00 A. M.	......	27.074	26.5	28.7	......	......	26.3	......	26.4	25.0	......	......	S. 1.	1.0.	
9 00	......	27.110	31.5	32.5	......	......	31.8	31.0	32.5	30.8	......	......	SE. 1.	1.0.	
11 00	......	27 114	49.0	39.8	......	......	39.0	38.5	59.0	41.8	......	......	W. 3.	0.4.	
1 00 P. M.	......	27.010	40.5*	41.0	......	......	40.5	33 0	46.8	42.0	......	......	E. 1.	1.0.	
3 00	......	26.968	40.6	42.5	......	......	41.0	32.3	45.0	41 8	......	......	E. 1.	1.0.	
5 03	......	26 934	37.5	37.8	......	......	37.0	33.0	38.0	37.0	......	......	E. 1.	1.0.	
7 37	......	26 908	34.5	34.8	......	......	34.0	33.8	35.0	34 5	......	......	SE 1.	1.0.	
March 2, 7 00 A. M.	......	26.880	28.0	29.5	......	......	28.5	27.5	29.5	28.5	......	0.05	NW. 3.	1.0.	Snow; ½ inch.
9 05	......	26.936	31.5	32.0	......	......	33.0	30 5	33.0	31.0	......	......	W. 1.	1.0.	Snowing.
11 00	......	26.982	34.5	34.8	......	......	34.5	31.5	34.8	31.8	......	......	SW. 1.	1.0.	Snowing.
1 00 P. M.	......	27.048	35.0	36.0	......	......	35.5	33.5	35.5	32.8	......	......	SW. 1.	1.0.	Snowing.
3 19	......	27.084	34.0	34.0	......	......	33.5	30.5	34 5	32.8	......	......	NW. 1.	1.0.	Snowing.
5 37	......	27.134	31 8	32.0	......	......	32.5	30.5	32.0	31.5	......	......	SE. 1.	1.0.	Snowing.
8 37	......	27.180	29.5	29.5	......	......	29.0	......	29.5	28 8	......	0.07	SE. 1.	0.8.	Snowing; ¾ inch.
March 3, 7 00 A. M.	......	27 260	28 0	29.0	......	......	25.5	......	26.8	25.8	......	......	Calm.	1.0.	Snowing.
8 26	......	27.254	30.5	31.8	......	......	31.0	......	31.5	29.0	......	......	SW. 1.	1 0.	
11 00	......	27.284	37.5	38.5	......	......	38.5	34 0	40.5	36 8	......	......	W. 1.	......	
0 50 P. M.	......	27.292	42.0	42.8	......	......	44.5	35.4	58 0	45.8	......	......	W. 1.	0.6.	
3 05	......	27.296	42.0	41.5	......	......	40.0	35.0	43.0	40.0	......	......	W. 1.	0.5.	
5 45	......	27 232	31.3	31 5	......	......	31.0	28.5	33.5	32.5	......	......	W. 1.	0.2.	
9 00	......	27.222	27.8	28.0	......	......	27.0	......	27 0	26.0	......	......	Calm.	0.8.	
March 4, 6 45 A. M.	......	27.255	20.8	21.0	......	......	20.0	......	20.8	19.8	......	......	W. 2.	0.2.	Before midnight snowing; after, northern light.
8 49	......	27.252	28 5	29.5	......	......	29.0	27.5	29.0	27.0	......	......	W. 1.	0.8.	
11 04	......	27.196	41.8	42.5	......	......	42.0	38.0	44.0	41.0	......	......	W.NW. 3.	1.0.	
1 21 P. M.	......	27 162	45.5	47.5	......	......	46.5	39 0	55.0	47.8	......	......	W. 2.	0.8.	
3 00	......	27.134	45.5	46.0	......	......	45.5	39.0	47.0	44 8	......	......	W. 3.	0.8.	
5 16	......	27 052	42.0	41.0	......	......	41.0	36.0	43.0	41.8	......	......	W. 2.	0.5.	
8 00	......	26.994	39.5	39.0	......	......	37.5	......	38.5	37 5	......	......	Calm.	0.6.	
11 45	......	26.940	26 0	26.0	......	......	25.5	......	26.0	25.3	......	......	W. 2.	0.8.	
March 5, 7 08 A. M.	......	26.817	19.3	21.0	......	......	20.0	......	20.0	19.3	......	......	NW. 2.	0.5.	
9 08	......	26.784	29 0	30.0	......	......	31.0	31.0	32.0	28.0	......	......	W. 2.	0.7.	
10 50	......	26.792	43.0	44.5	......	......	46.0	41.3	50.0	46.0	......	......	W. 4.	1 0.	
0 20 P. M.	......	26.792	44.8	45.0	......	......	43.5	36.5	45.0	43.0	......	......	W SW. 2.	1.0.	Snowing.
1 48	......	26.764	45.0	45.5	......	......	44.5	37.8	49.0	44.5	......	......	W. 2.	0.9.	
3 43	......	26.738	44.0	44.5	......	......	44.0	36.5	46.0	44.0	......	......	W. 2.	1.0.	

[illegible]	......	[illegible].700	40.0	40.0	......	......	[illegible].0	[illegible].5	40.[illegible]	[illegible].5	......	......	W. [illegible].	1.0.	
7 [illegible]	......	[illegible].675	[illegible].5	[illegible].5	......	......	[illegible].0	......	27.0	[illegible].0	......	......	SW. 2.	0.5.	
10 15	......	[illegible].650	35.0	[illegible].0	......	......	35.0	......	[illegible].0	[illegible].0	......	0.05	SW. 2.	1.0.	Snow; ½ inch.
March 6, 7 00 A. M.	......	26.786	28.0	28.0	......	......	27.5	26.5	27.5	26.0	......	......	NW. 3.	1.0.	
9 00	......	26.795	31.5	32.5	......	......	32.5	31.0	32.5	31.2	......	......	W. 2.	1.0.	
11 00	......	26.850	42.0	36.5	......	......	37.3	31.0	48.5	37.7	......	......	W. 2.	0.5.	
1 15 P. M.	......	26.844	37.5	38.5	......	......	39.3	33.5	42.3	37.7	......	......	W.SW. 3.	1.0.	
3 45	......	26.866	36.0	36.5	......	......	35.0	32.0	35.3	33.5	......	......	W 1.	1.0.	Snowing.
6 00	......	26.884	29.5	30.5	......	......	29.0	28.0	29.0	28.0	......		NW. 2.	1.0.	Snowing.
8 30	......	26 900	29.5	29.5	......	......	29.0	27.8	29.0	28.0	......	0.17	W.SW. 1.	1.0.	Snowing; 1½ inch.
March 7, 6 45 A. M.	......	27.170	25 5	26.5	......	......	23.5	......	24.5	23.5	......	......	W. 1.	0.6.	
9 00	......	27.240	33.5	35.5	......	......	33.2	31.3	36.0	31.5	......	......	W. 2.	0 7.	
11 00	27.090	27.342	41.0	39.5	......	......	38.5	35.5	45.0	34.0	......	......	W. 2.	0.7.	Snowing.
0 22 P. M.	27.130	27.342	38.5	41.0	......	......	40.0	37.0	49.0	40.0	......	......	W. 2.	0.8.	
2 12	27.180	27.420	41 0	41.5	......	......	36 0	34.0	39.5	34.8	......	......	SW. 4.	0.9.	
4 00	27.224	27.464	36.0	36.0	......	......	34.5	31 0	35.8	33.8	......	......	W. 2.	0.6.	Snowing.
5 34	27.260	27.496	33.8	34.0	......	......	30.8	32.0	32.3	31.4	......	......	W. 1.	1.0.	
8 42	27.295	27.528	28.0	28.0	......	......	26.5	......	27.0	26.0	......	......	W. 2.	1.0.	
11 58	......	27.572	28.5	28.0	......	......	27 5	......	28 0	27.8	......	......	W. 2.	1.0.	
March 8, 7 00 A. M.	27.333	27.644	20.0	21.0	......	......	18.8	......	19.2	18.2	......	......	W. 1.	Cir. 0.5.	
8 50	27.360	27.672	35.5	35.5	......	......	32.5	32.5	45 5	31 0	......	......	NW. 2.	Cir. 0.5.	
10 40	27.370	27.664	41.0	43.0	......	......	40.5	37.5	50.0	39.0	......	......	W. 1.	0.8.	
1 15 P. M.	27.350	27.600	45.3	45.8	......	......	48.5	42 0	64.0	51.0	......	......	W 1.	0.5.	
3 05	27 330	27.590	49.0	49 5	......	......	46.0	37.5	48.0	46.0	......	......	W. 1.	Clear.	
5 05	27.305	27.577	42.7	42.5	......	......	44.0	35.4	44.5	43.0	......	......	NW. 1.	Clear.	
8 12	27.258	27.526	28.0	28.0	......	......	26 5	......	27.0	26.5	......	......	NW. 1.	Clear.	
March 9, 1 00 A. M.	27.242	27.508	21.5	20 8	......	......	19.0	......	20.0	19.5	......	......	NW. 1.	Clear.	
7 00	27.224	27.524	16.7	18.0	......	......	16 0	......	16.5	16.0	......	......	Calm.	Clear.	
8 45	27.238	27.524	34.5	37.0	......	......	29.5	......	42.0	31.0	......	......	W. 1.	Clear.	
Noon.	27.242	27.531	48.7	49 5	......	......	48.5	42.5	65 0	50.0	......	......	Calm.	Clear.	
2 00 P. M.	27.203	27.498	56.0	58.0	......	......	54.8	46.0	75.0	63 5	......	......	Calm.	0.1.	
4 00	27.205	27.492	56.0	57.5	......	......	55.2	41.0	65.3	59.5	......	......	S. 1.	0.1.	
6 25	27.185	27.418	35.2	36 3	......	......	35.3	32.3	37.0	35.5	......	......	S. 1.	0.1.	
8 00	27.190	27.434	30.2	32 0	......	......	29.4	28.7	......	......	......	......	S. 1.	Clear.	
March 10, 3 00 A. M.	27.242	27.510	21.0	20.0	......	......	19.0	......	20.0	19.0	......	......	NW. 1.	Clear.	
6 30	27.252	27.557	17.7	18 2	......	......	16.3	......	17.3	16.5	......	......	W. 1.	Clear.	
9 10	27.308	27.605	40.5	42.0	......	......	34.0	33.5	47.0	34.5	......	......	E.NE. 1.	Clear.	
11 00	27 322	27.611	47.7	48.5	......	......	45 5	41.0	61.0	47.5	......	......	S. 1.	Clear.	
0 20 P. M.	27.305	27.564	52 0	52.3	......	......	50.5	46.5	66 0	55 0	......	......	S. 1.	Clear.	
2 45	27.255	27.536	60 0	59.5	......	......	55.5	46.0	59.0	56.4	......	......	W. 1.	Cir. 0 5.	
4 45	27.240	27.516	52.0	51.8	......	......	54.0	42.0	56.0	53.0	......	......	SW. 1.	0 8.	
6 51	27 238	27.506	36.0	35.0	......	......	36.0	......	37.5	36.0	......	......	W. 1.	0.4.	
8 15	27.240	27.508	33.0	33.5	......	......	32.5	......	33.0	32 5	......	......	Calm.	0.4.	
March 11, 2 45 A. M.	27.273	23.543	28.0	29.5	......	......	27.5	......	28.0	27.0	......	......	W. 1.	1.0.	
4 00	27.293	27.549	29.5	30.3	......	......	27.8	......	28.5	27.5	......	......	N. 1.	1.0.	
6 50	27.310	27.587	28 5	29.0	......	......	28.0	......	28.7	28.0	......	......	SW. 1.	1.0.	
8 30	27.335	27.628	35.0	35.0	......	......	32.8	......	35 0	32.5	......	......	W. 1.	0.7.	
9 30	27.364	27.663	44.0	48.5	......	......	41.0	39.6	54.3	41.5	......	......	SW. 2.	0.4.	
10 30	......	27.688	55 8	......	......	......	48.1	42.1	61.8	47.3	......	......	SE. 3.	0.2.	
11 30	......	27.675	58.5	......	......	......	54.8	46 8	74.0	55.0	......	......	SE. 2.	0.2.	
0 30 P. M.	......	27.650	61.2	......	......	......	58.8	48.6	68.7	58.7	......	......	SE. 1.	0.7.	
1 30	......	27.642	60.6	......	......	......	62.0	49.1	78.8	65.9	......	......	SE. 1.	0 3.	
2 30	......	27.641	67.0	......	......	......	62.4	52.0	75.0	66.8	......	......	SE. 2.	0.3.	

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.	Aneroid.	Barometer.	Attached.	Detached.	INSIDE. Dry.	INSIDE. Wet.	OUTSIDE. Dry.	OUTSIDE. Wet.	Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
1860. h. m.			°	°	°	°	°	°	°	°	°			°	
March 11, 3 30 P. M.	....	27.643	66.9	......	......	......	62.3	48.8	78.0	66.9	......	......	NE. ½.	Clear.	
4 30	....	27.636	63.7	......	......	......	60.0	47.8	80.6	65.3	......	......	N. ½.	Clear.	
5 30	....	27.622	49.6	......	......	......	49.1	42.7	51.4	49.4	......	......	SE. ½.	0.1.	
7 40	27.353	27.624	35.4	......	......	......	34.5	......	36.0	35.0	......	......	W. 1.	Clear.	
March 12, 3 15 A. M.	27.335	27.636	23.8	......	......	......	23.0	......	24.9	23.5	......	......	Calm.	Clear.	
4 45	27.338	27.643	23.7	......	......	......	21.5	......	22.5	22.0	......	......	Calm.	Clear.	
7 00	27.342	27.635	21.3	......	......	......	21.0	......	21.5	20.7	......	......	SW. 1.	Clear.	White frost.
9 00	27 340	27.632	41.5	41.0	......	......	37.0	35.5	46.0	36.0	......	......	SW. 1.	Clear.	
11 00	27.320	27.618	53 0	56.0	......	......	49.0	44.5	64.0	50.0	......	......	Calm.	Clear.	
1 05 P. M.	27.260	27.516	56.5	58.0	......	......	59.0	49.0	76.0	63.0	......	......	Calm.	0.2.	
3 05	27.225	27.450	63.0	65.0	......	......	60.0	47.0	65.0	61.0	......	......	Calm.	0.3.	
5 53	27.155	27.414	44.0	44.5	......	......	42.5	38.5	44.0	42.5	......	......	Calm.	0.4.	
8 00	27.105	27.384	34.0	34.5	......	......	32.5	......	33.0	32.5	......	......	NW. 1.	Clear.	
March 13, 4 25 A. M.	26.935	27.298	24.0	25.0	......	......	23.0	......	24.0	23.0	......	......	W. 1.	0.3.	Black and naked bulb put on top of a stump, (pitch pine.)
6 50	26.893	27.192	24.5	25.5	......	......	24.5	......	25.0	24 0	......	......	S. 1.	0.7.	
9 00*	26.875	27.193	41.5	44.5	......	......	39.8	34.2	68.0	57.5	......	......	S. 1.	0.4.	
11 00	26.853	27.173	54.8	56.5	......	......	53.5	48.7	97.6	75.5	......	......	S. 1.	0.4.	
1 00 P. M.	26.827	27.112	57.5	59.3	......	......	58 0	......	70.3	69.5	......	......	S. 2.	0.9.	
2 00	26.844	27.118	56.0	56.0	......	......	56.0	46.0	59.8	56.8	......	......	SW. 4.	1.0.	A few drops of rain.
4 00	26.942	27.182	46.0	46.5	......	......	48.0	43.0	47.5	46.5	......	......	SW. 3.	1.0.	
5 00	....	....	......	......	47.0	41.5	......	......	....	....	49.0	......	....	....	River 1 inch above low water.
6 00	26.995	27.282	44.0	......	......	......	43.0	40.5	43.8	43.0	......	......	W. 1.	....	
March 14, 5 30 A. M.	27.205	27.517	31.0	32.0	......	......	32.0	......	31.5	31.0	......	0.03	W. 1.	0.9.	Rain.
7 00	27.244	27.598	32.5	34.0	......	......	33.0	30.7	53.5	47.0	......	......	SW. 1.	0 9.	
9 00	27.272	27.576	46.5	50.0	......	......	49.5	47.5	87.9	66.5	......	......	W. 2.	0.7.	
11 00	27.270	27.568	59.3	54.0	......	......	51.5	46.5	95.7	65.0	......	......	W. 1.	0.1.	
0 40 P. M.	27.243	27.516	51.0	50.0	......	......	50.5	45.0	96.5	78.2	......	......	S. 2.	....	Haze.
2 30	27.192	27.475	54.0	55.5	......	......	56.2	45 5	60.5	55.9	......	......	W. 2.	0.7.	
5 00	27.155	27.438	48.5	49.0	45.5*	40 2	50.7	44.5	49.2	47.5	43.0*	......	W. 1.	1.0.	* 45 minutes later.
6 40	27.086	27.364	38.0	38.0	......	......	38.0	34.7	38.0	37.0	......	......	W. 1.	1.0.	
March 15, 6 50 A. M.	26.857	27.155	33.2	34.0	......	......	33.8	33.0	33.5	33.0	......	......	SW. 1.	1.0.	
8 00	....	....	......	......	37.0	36.0	......	......	39.5	37.0	41.5	......	....	....	
10 00	26.873	27.160	44.8	44.0	......	......	45.6	43.0	51.2	46.5	......	......	W.NW. 1.	1.0.	
Noon.	26.875	27.188	58.5	56.0	......	......	56.3	47 5	72.5	61.5	......	......	W. 4.	1.0.	
2 00 P. M.	26.843	27.134	53.7	55.0	......	......	54.0	45.0	56.0	54.3	......	......	W. 4.	0.9.	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	W. 2.	0.2.	
March 16, 7 00 A. M.	[illegible]	[illegible]	[illegible]	[illegible]	......	......	[illegible]	[illegible]	[illegible]	[illegible]	......	......	W. 1.	1.5.	Raining.
9 40	[illegible]	[illegible]	48.7	44.3	37.0	34.0	44 3	40.7	48.3	44.8	41.0	......	W. 2.	1.0.	River 3½ inches above low water.
0 30 P. M.	26.573	26.874	51.5	54.0			51.5	46.6	63.2	54.5		......	W. 2.	1.0.	Raining.
3 30	26.503	26.798	44.5	46.0	......	......	45.5	43.2	45.0	41.7	......	......	W. 2.	1.0.	Raining.
6 15	26.505	26.792	36.0	36.5	......	......	36.2	34.8	35.7	34.8	......	0.15	NW. 4.	1.0.	Snow; 1 inch.
March 17, 6 40 A. M.	26.885	27.224	27 0	27.2	......	......	27.0	26 0	25.5	24.0	......	......	W. 3.	0.3.	
9 00	26.975	27.292	36 0	38.0	......	......	35.7	33.0	46.0	35.7	......	......	W. 3.	0.8.	
Noon.	27.008	27.310	37.0	38.0	34.0	31.5	37.5	35.7	42.7	35.2	36.5	......	W. 3.	1.0.	
2 30 P. M.	26.977	27 284	38.7	40.0	......	......	39.2	36.5	41.8	37.0	......	......	W.SW. 3.	1.0.	
6 00	26.897	27.212	35.0	36.0	......	......	35.5	34.0	33.2	32.3	......	0.17	W.SW. 1.	1.0.	
March 18, 6 30 A. M.	26.997	27.317	21.7	22.5	......	......	21.5	20.0	25.2	21.5	......	......	W. 2.	0.2.	Snow; 1½ inch.
9 00	27.067	27.387	29.7	30.0	......	......	30.0	28.0	32.0	27.3	......	......	W.SW. 3.	1.0.	
11 00	27.113	27.419	41.5	42.0	......	......	39.2	35.5	56.7	41.5	......	......	W.SW. 3.	0.9.	
1 00 P. M.	27.125	27.425	38.5	39.5	......	......	39.2	33.7	44.3	34.5	......	......	NW. 4.	0.9.	Snowing.
3 00	27.123	27.419	41.2	42.0	......	......	43.2	34.5	33.2	32.0	......	......	W. 5.	0.7.	
5 00	27.147	27.433	32.5	33.0	33.0	28.5	33.7	30.2	35.5	33.5	38.7	......	W. 4.	0.2.	
7 00	27.190	27.464	25 0	25.3			24.5	......	24.0	23.5		......	W. 2.	0 3.	River 5 inches above low water.
March 19, 6 15 A. M.	27.343	27.652	12.0	12.2	......	......	11 3	......	9.5	8.5	......	......	Calm.	Clear.	
7 30	27.342	27.650	20.0	21.8	21.5	20.0	18.3	17.5	38.7	23.5	35.2	......	Calm.	Clear.	
9 00	27.333	27.644	30.5	30.5			36.5	31.2	63.5	47.0		......	E. 1.	0.2.	
11 10	27.275	27.586	39.5	39.2	......	......	40.0	36.5	86.3	64.2	......	......	E. 1.	0.4.	
1 10 P. M.	27.192	27.496	42.5	43.7	......	......	43.7	39.7	72.5	60.7	......	......	E. 2.	1.0.	
2 30	27.159	27.455	44.0	45.0	......	......	45.2	40.7	54.5	45.0	......	......	E.NE. 3.	1.0.	
4 30	27.078	27.375	43.8	44.2	......	......	45.2	42.0	45.5	41.7	......	......	E. 1.	1.0.	
6 00	27.026	27 324	35.7	36.0	34.0	31.5	35.3	33.0	34.3	33.7	38.0	......	Calm.	1.0.	
8 00	26.985	27.296	30.0	29.7			29.7	28.0	29.5	28 5		......	Calm.	0.4.	
March 20, 6 30 A. M.	26.837	27.136	29.5	31.0	30.5	29.5	31.0	30.0	29.5	28.0	37.0	......	W. 1.	0.9.	
9 00	26.845	27.134	36.8	37.0			37.0	34.5	42.5	37.0		......	NW.	1 0.	Snowing.
11 00	26.843	27.136	43.0	47.5	......	......	45.8	42.5	56.5	46.7	......	......	W. 1.	1.0.	Snowing.
1 00 P. M.	26.818	27.130	42 7	43.3	......	......	43.3	41.3	43.0	39.0	......	......	W.SW. 1.	1.0.	Raining.
3 00	26.778	27.098	41.0	42.0	......	......	41.7	38.0	41.8	38 2	......	0.17	W.SW. 1.	1.0.	Raining.
4 30	26.780	27.060	40.0	40.8	......	......	40.0	38.5	38.0	36.5	......	......	W. 1.	1.0.	
March 21, 6 30 A. M.	26.868	27.148	29.0	31.0	32.5	31.5	30.0	......	28.5	27.0	36.5	......	Calm.	0.6.	Snowing.
7 34	26.890	27.196	35.5	34.8			35.5	34.5	51.5	43.5		......	Calm.	0.5.	
8 54	26.920	27.196	35.5	35.0	......	......	34.5	33.5	33.0	31.5	......	......	W. 1.	1.0.	Snowing.
10 30	26.933	27.228	43.7	43.0	......	......	45.0	43.0	63.7	50.4	......	......	W.SW. 1.	0.7.	Snowing.
11 54	26.959	27.232	45.4	45.0	......	......	46.0	41.8	59.5	46.0	......	......	SW. 3.	0.9.	
2 00 P. M.	......	27.276	45.3	45.5	......	......	46.5	41.5	56.0	45.5	......	......	W. 1.	0.8.	
4 16	27.050	27.314	45 5	47.8	......	......	50.0	44.8	41.5	37.0	......	......	W. 1.	0.4.	
6 00	27.060	27.316	31.5	32.0	......	......	31 0	30.0	29.0	28.5	......	......	Calm.	0.4.	
9 20	27.100	27.354	23.0	23.5	......	......	22.5	......	21.0	20.0	......	......	Calm.	Clear.	
March 22, 6 15 A. M.	27.194	27.412	18.0	18.3	......	......	18.0	......	15.0	13.5	......	......	Calm.	0.2.	
8 00	27.143	27.440	31.5	33.0	29.0	28.0	30.0	29.0	52.5	30.0	36.0	......	E. 1.	0.4.	
9 35	27.150	27.498	46.0	45.2	......	......	44.8	40.5	83.0	58.5	......	......	SE. 1.	0.1.	
11 12	......	27 418	45.5	......	......	......	45.5	40.5	85.5	62.0	......	......	SE. 3.	0.2.	
0 55 P. M.	......	27.342	45.0	......	......	......	44.8	38.0	86.2	65.2	......	......	NE. 3.	0.3.	
2 50	......	27.322	48.5	......	......	......	50.5	44.0	51.0	48.0	......	......	NE. 3.	0.5.	
5 00	......	27.292	43.5	......	......	......	44.2	39.5	47.3	44.3	......	......	NE. 3.	0.9.	
6 30	......	27.252	38.5	......	......	......	39.0	38.5	38.0	37.0	......	......	NE. 1.	1.0.	
9 30	......	27.152	32.5	......	......	......	32.0	......	32.0	31.0	......	......	SW. 2.	0.2.	
March 23, 6 30 A. M.	......	27.132	27.8	......	......	......	29.0	......	28.0	26.5	......	......	NW. 1.	1.0.	
8 16	......	27.126	31.8	......	33.0	......	32.0	31.5	35.5	32.0	37.0	......	W. 1.	1.0.	

Meteorological observations—Continued.

BITTER ROOT OBSERVATORY.

Date.		Aneroid.	Barometer.	Attached.	Detached.	Inside.		Outside.		Black.	Naked.	Water.	Rain.	Wind.	Clouds.	Remarks.
						Dry.	Wet.	Dry.	Wet.							
1860.	h. m.			°	°	°	°	°	°	°	°	°				
Mar. 23,	10 00 A. M.	....	27.118	38.0	......	......	......	40.0	38.0	47.0	40.0	......	......	Calm.	1.0.	
	0 11 P. M.	....	27.134	45.0	.....	......	......	46.0	41.5	49.5	44.5	......	......	Calm.	1.0.	
	1 56	....	27.176	39.8	......	......	.....	40.5	38.8	39.0	36.0	......	......	S.W.	1.0.	Raining.
	4 08	....	27.226	35.5	......	......	......	36.0	35.0	33.0	31.5	......	......	W.	1.0.	Snowing.
	6 00	....	27.290	34.0	......	......	....	34.0	33.0	33.0	32 0	......	......	W.	1 0.	Snowing.
	7 45	....	27.330	32.7	......	......	.....	33.5	32.5	32.5	31.7	......	......	W. 1.	1.0.	
Mar. 24,	6 15 A. M.	....	27.564	33.0	......	......	......	34.0	33.0	31.8	31.0	......	......	NE. 1.	0.9.	Snowing.
	7 37	....	27 600	34 0	......	......	34.0	34.0	33.0	36.0	32.5	37.0	0.13	NE. 1.	0.9.	Snowing.
	9 12	....	27.652	46.3	......	......	......	46.0	44.5	88.0	55.5	......	......	Calm.	0.4.	
	11 07	....	27.652	52.5	......	......	......	51.5	49.0	105.0	66.5	.....	......	W. 1.	0.3.	
	0 17 P. M.	....	27.650	54.0	......	......	......	54.5	49.0	106.0	73.0	.. ..	......	NE. 1.	0.4.	
	2 04	....	27.658	50.5	......	.....	......	52.2	46.2	67.0	56.0	......	......	SW. 1.	0.2.	

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Wind.	Clouds.	Remarks.
1860. h. m.			°	°	°	°	°			
Mar. 24, 4 30 P. M.	Bitter Root observatory	27.644	46.5	47.0	44.0	46.0	45.0	W. 1.	0 4.	
5 44	do.........do	27.642	45.0	46.8	42.5	45.0	43.5	NE. 1.	0.5.	
8 00	do.........do	27.622	30.8	30.8	29.5	29.5	28.8	Calm.	Clear.	
9 32	do.........do	27.616	28.3	29.0	28.0	26.0	25.3	SW. 1.	Clear.	
Mar. 25, 6 20 A. M.	do.........do	27.685	23.5	24.0	....	24.0	21.0	W. 1.	0.5.	White frost.
8 11	do.........do	27.672	38.0	38.0	35.0	60.0	47.5	W. 1.	0.1.	
10 00	do.........do	27.700	49.0	49.0	44.0	89.5	67.5	Calm.	0.1.	
11 45	do.........do	27.704	52.7	53.2	....	105.5	82.5	S. 1.	Clear.	
2 03 P. M.	do.........do	27.658	56.8	58.5	50 0	91.0	72.0	SE. 2.	Clear.	
4 40	do.........do	27.596	51.0	52.0	46.0	65.5	57.0	S.SE. 2.	Clear.	
6 05	do.........do	27.600	42.8	42.3	42.0	41.5	41.0	W. 1.	Clear.	
10 20	do.........do	27.596	22.0	22.0	....	....	....	N. 1.	Clear.	
Mar. 26, 6 00 A. M.	do.........do	27.597	18.5	19.2	....	....	....	S. 1.	Clear.	
3 30 P. M.	1st camp, 9 miles above	27.453	60.3	....	....	....	....	S.SW.	Clear.	First flower seen.
4 49	do.........do	27.430	58.0	....	....	....	....	S.SW.	Clear.	
8 35	do.........do	27.398	31.2	....	....	....	....	S. 1.	Clear.	
Mar. 27, 6 00 A. M.	do.........do	27.448	19.0	....	....	....	....	S. 1.	Clear.	
7 45	do.........do	27.452	30.2	....	....	....	....	S. 1.	Clear.	
4 00 P. M.	2d camp, 25 miles above	27.288	68.3	....	....	....	....	....	Clear.	15 feet above water.
5 10	do.........do	27.262	58.7	....	....	....	....	....	Clear.	
7 00	do.........do	27.228	39.0	....	....	....	....	....	Clear.	
Mar. 28, 6 30 A. M.	do.........do	27.236	25.0	....	....	....	....	....	Clear.	White frost.
Mar. 29, 6 20 A. M.	3d camp, 43 miles above	26.802	32.5	....	....	....	....	Calm.	Clear.	15 feet above water.
7 10	do.........do	26.802	39.0	....	....	....	....	E. 2.	Clear.	
3 50 P. M.	4th camp, 61 miles above	26.549	76.0	....	....	....	....	S. 1.	Clear.	9 feet above water.
6 15	do.........do	26.512	54.8	....	....	....	....	W. 2.	Cir. stra. 0.2.	
Mar. 30, 6 45 A. M.	do.........do	26.566	36.7	....	....	....	....	Calm.	0.3.	
9 27	Pelkies' place	26.568	56.3	....	....	....	....	....	....	
10 45	do	26.556	52.0	....	....	....	....	....	....	
0 40 P. M.	do	26.512	53.0	....	....	....	....	....	....	
6 00	Hell Gate observatory	26.452	60.0	....	....	....	....	N. 2.	0.9.	
7 30	do.........do	26.478	51.8	....	....	....	....	E. 2.	1.0.	

Meteorological observations—Continued.

HELL GATE.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	WATER. River.	WATER. Creek.	GAUGE. River.	GAUGE. Creek.	Rain.	Wind.	Clouds.	Remarks.
1860.	h. m.		°	°	°	°	°	°	°	*In.*					
Mar. 31,	6 00 A. M.	26.614	39.7	......	......	......	......	......	......	......	......	......	E. 2.	1.0.	
	7 30	26.630	42.8	......	......	......	......	......	......	......	......	......	E. 1.	1.0.	
	10 00	26.691	49.2	......	......	......	......	......	......	......	......	......	S. 1.	1.0.	
	0 20 P. M.	26.706	62.7	59.2	......	86.5	71.5	......	......	......	......	......	E. 1.	0.8.	
	2 15	26.700	60.5	56.7	47.0	76.3	68.0	......	......	......	......	......	NW. 1.	0.8.	
	4 30	26.696	55.0	54.5	45.7	56 8	55.2	......	......	......	......	......	NW. 1.	0.9.	
	6 00	26.698	51.3	52.0	45.5	52.3	51.2	......	......	......	......	......	W. 1.	0.9.	
	8 15	26.692	45.8	......	......	46.5	45.2	......	......	......	......	......	W. 2.	1.0.	
Apr. 1,	6 20 A. M.	26.715	29.8	30.2	29.5	......	......	......	......	......	......	......	N. 1.	0.1.	
	8 15	26.727	44.5	42.0	40.0	55.5	42.5	42.2	37.5	......	......	......	Calm.	0.1.	
	10 45	26.732	59.7	53.2	46.0	72.2	59.3	......	......	......	......	......	W. 1.	0.6.	
	11 45	26.728	62.7	59.5	51.0	83.7	63.3	......	......	......	......	......	W. 1.	0.8.	
	2 00 P. M.	26.686	61.7	60.3	49.2	67.5	57.5	......	......	......	......	......	W. 1.	0.8.	
	3 30	26.666	65.0	60.0	49.0	91.2	73.2	47.3	46.0	......	......	......	W. 3.	0.3.	
	5 00	26.600	57.0	57.0	45.0	59.2	56.0	......	......	......	......	......	W. 2.	0.2.	
	7 30	26.588	47.0	46.0	42.0	46 0	45.2	......	......	......	......	......	W. 1.	0.2.	
	9 20	26.570	38 0	38.0	36.0	36.5	38.0	......	......	......	......	......	W. 1.	0.2.	
Apr. 2,	6 15 A. M.	26.474	28.5	29.0	28.0	29.5	29.0	41.0	36.7	......	......	......	N. 1.	0.4.	
	8 00	26.468	42.3	40.5	38.0	50.0	41.5	41.2	37.3	0.4	......	......	Calm.	0.9.	
	10 00	26.443	55.3	48.5	43.3	68.0	55.0	41 8	39.3	0.5	......	......	W. 1.	0.7.	
	Noon.	26.364	68.5	60.5	47.2	84.7	67.8	42.8	41.3	0.6	......	......	SW. 4.	0.8.	
	3 15 P. M.	26.248	56.8	55.7	45.7	......	56.0	43.7	42.7	1.1	......	......	W.SW. 7.	1.0.	
	5 30	26.184	51.7	51.6	39.0	......	......	43.5	41.7	1.1	......	......	W. 4.	0.9.	
	8 10	26.096	46.3	......	......	......	......	......	......	......	......	......	W. 5.	1.0.	
Apr. 3,	7 00 A. M.	26.144	27.2	26.7	25.2	......	26.5	39.2	35.3	......	......	......	W. 2.	0.9.	Rain and snow ½ inch, or 0.05 water.
	10 30	26.222	34.8	31.5	30.5	......	33.5	39.2	36.0	......	......	......	W. 4.	1.0.	
	0 45 P. M.	26.267	45.7	36.0	33.5	......	43.5	39.3	38.2	......	......	......	W. 3.	0.9.	After 2 p. m. a snow storm from the west; ¾ inch.
	3 15	26.270	36.3	33.0	32.0	......	36.5	40.0	39.2	......	......	......	W. 2.	......	
	5 45	26.300	30.2	27.5	27.0	......	28.5	39.0	37.0	......	......	......	W. 4.	1.0.	During the night snow storm, ½ inch; water 0.03.
Apr. 4,	7 00 A. M.	26.280	24.5	24.5	......	......	......	......	......	......	......	......	E. 5.	1.0.	
	11 30	26.215	34.2	......	......	......	......	......	......	......	......	......	E. 5.	1.0.	
	1 00 P. M.	26.196	30.3	41.0	37.0	......	39.0	36.2	36.5	—0.5	......	......	E. 3.	1.0.	
	2 50	26.140	41.3	40.2	36.0	......	40.5	37.3	36.0	—0.4	......	......	E. 3.	1.0.	Snow storm; 1 inch snow.
Apr. 5,	7 00 A. M.	[illegible]	31.7	31.0	30.5	......	......	......	......	......	......	......	Calm.	1.0.	Snowing.
	9 30	[illegible]	35.3	33.5	30.0	......	34.5	36.3	36.3	—1.6	......	......	NE. 2.	1.0.	Snowing.

	Noon.	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	37.0	37.0	—1.8	......	0.11	SW. 2.	1.0.	Snowing.
	3 00 P. M.	26.500	44.5	39.3	30.0	......	42.9	37.8	30.0	—1.5	......	......	SW. 3.	0.7.	
	5 00	26.508	37.2	35.5	31.5	......	38.5	38.3	36.5	—1.4	......	......	W. 2.	1.0.	Snow ¼ inch.
Apr. 6,	1 00 A. M.	26.546	24.8	......	......	......	......	......	......	......	......	......	E. 2.	Clear.	
	5 30	......	21.0	......	......	......	......	......	......	......	......	......	E. 3.	Clear.	
	7 30	26.538	26.5	27.5	......	......	26.0	34.2	33.9	—2.1	......	0.03	S.SW. 2.	1.0.	Snowing.
	11 50	26.542	45.5	39.5	37.5	......	41.0	36.5	37.0	—3.0	......	......	SE. 3.	0.4.	
	5 00 P. M.	26.542	36.0	33.0	32.0	......	34.5	36.0	38.2	—3.0	......	......	W. 2.	0.6.	1 p. m. snow storm.
	Midnight.	26.546	25.2	......	......	......	......	......	......	......	......	......	SE. 1.	0.2.	
Apr. 7,	1 00 A. M.	26.542	24.0	......	......	......	......	......	......	......	......	......	SW. 1.	0.8.	
	7 00	26.564	25.5	24.0	22.5	27.0	25.5	33.7	32.0	—3.9	......	......	E. 3.	0.6.	
	9 00	26.560	41.8	38.7	37.0	48.3	38.0	35.0	33.5	—4.0	......	......	NE. 2.	0.9.	Add 3 inches to old scale.
	Noon.	26.556	50.0	42.5	38.5	40.0	47.0	37.3	37.0	—1.1	......	......	W. 2.	1.0.	New scale.
	2 30 P. M.	26,508	41.8	37.0	35.0	39.3	38.7	......	38.0	—1.1	......	......	W. 2.	1.0.	Snowing.
	5 00	26.496	39.5	39.0	36.0	40.0	38.5	39.0	38.2	—0.8	......	0.01	SE. 2.	0.9.	
Apr. 8,	1 30 A. M.	26.476	24.5	......	......	......	......	......	......	......	......	......	S. 1.	0.1.	Snowing, ¼ inch. Weather since the beginning of April very uncertain. Between the readings one or several snow storms; 18 in one day.
	2 45	26.468	24.5	......	......	......	......	......	......	......	......	......	W. 1.	0.9.	
	7 00	26.446	22.5	22.0	......	24.0	23.5	25.5	32.8	—1.4	......	......	SW. 1.	0.3.	
	9 00	26.440	42.0	39.5	37.5	45.0	43.0	37.0	34.5	—1.4	......	......	E. 1.	0.7.	
	11 00	26.458	49.8	42.2	40.5	55.8	48.0	39.0	38.0	—1.6	......	......	Calm.	0.8.	
	1 00 P. M.	26.458	56.7	46.0	42.0	57.0	55.0	41.0	41.0	—1.7	......	......	Calm.	1.0.	
	3 00	46.464	47.2	45.5	41.0	46.5	46.2	42.0	41.0	—1.7	......	......	W. 1.	1.0.	
	6 00	26.512	39 0	37.3	35.7	39.0	38.5	40.3	39.2	—1.3	......	......	SW. 3.	1.0.	
Apr. 9,	2 15 A. M.	26.727	27.0	......	......	......	......	......	......	......	......	......	E. 2.	0.6.	
	4 05	26.724	27 0	......	......	......	......	......	......	......	......	......	E. 1.	Clear.	
	7 00	26.850	32.7	31.0	29.5	40.0	35.3	38.3	34.2	—1.4	......	......	NE. 1.	0.2.	
	10 10	26.930	51.8	43.2	40.7	62.5	49.0	40.0	37.2	—1.6	......	......	W. 1.	0.3.	
	1 00 P. M.	26 917	55.2	48.5	38.7	56.5	51.3	42.3	41.0	—1.6	......	......	W. 2.	0.9.	
	4 10	26.897	54.0	48.0	38.5	66.5	57.0	44.2	44.2	—1.4	......	......	W. 2.	0.5.	
	7 00	26.872	39.7	39.2	35.5	39.3	39.0	42.2	41.5	—1.1	......	......	W.SW. 2.	0.6.	
Apr. 10,	3 50 A. M.	26.780	39.5	30.0	......	......	......	......	......	......	......	......	W. 3.	1.0.	At 6 a. m. min. 37.0 deg.
	7 00	26.764	39.0	30.0	35.5	40.0	39.5	40.0	32.5	—1.5	......	......	SW. 1.	1.0.	
	9 00	26.731	44.7	45.0	39.4	45.3	43.5	40.2	38.0	—1.6	......	......	SW. 3.	1.0.	Intermediate snow and rain storms.
	11 00	26.720	48.7	46.3	39.7	46.5	45.3	41.0	39.0	—1.6	......	......	W.SW. 5.	1.0.	
	1 00 P. M.	26.722	46.0	42.0	41.5	47.7	41.5	42.0	40.5	—1.5	......	0.03	W. 2.	0.9.	
	3 00	26.736	41.0	38.5	36.0	42.0	40.3	41.5	40.7	—1.4	......	......	W. 2.	1.0.	
	5 00	26.802	39.8	38.0	35.7	40.0	38.3	41 2	40.0	—1.4	......	......	W. 2.	0.9.	
	7 00	26.822	36.5	36.0	34.0	36.0	34.5	41.0	39.5	—1.4	......	......	W. 1.	0.9.	
	8 30	26.958	33.0	......	......	......	......	......	......	......	......	......	Calm.	Clear.	
Apr. 11,	4 15 A. M.	26.920	20.5	......	......	......	......	......	......	......	......	......	Calm.	Clear.	First fair day in this month.
	6 00	26.980	20.7	20.3	20.0	19.5	19.3	37.7	33.5	—1.6	......	......	Calm.	Clear.	
	8 00	27.012	35.2	33.7	31.2	43.0	33.3	38.2	33 7	—1.6	......	......	W. 1.	0.1.	
	10 10	27.070	53.4	42.7	40 0	64.5	48.5	41.3	37.5	—1.6	......	......	W. 1.	0.2.	
	1 00 P. M.	27.062	54.2	51.2	41.0	83.2	62.6	44.0	43.0	—1.6	......	......	W. 3.	0.3.	
	3 00	27.058	62.0	53.0	42.5	71.5	50.7	45.5	45.5	—1.7	......	......	W. 3.	0.3.	
	5 00	27.052	51.7	50.2	41.4	52.0	49.3	45.5	45.0	—1.7	......	......	W.SW. 2.	0.1.	
	7 00	27.042	40.8	40.5	37.0	40.0	39.5	44.5	43.2	—1.7	......	......	Calm.	Clear.	
	8 45	27.061	33.5	32.0	30.5	31.7	31.2	......	......	......	......	......	NE. 1.	Clear.	
Apr. 12,	5 00 A. M.	27.064	28.0	33.0	31.7	......	......	......	......	......	......	......	NE. 1.	Clear.	
	7 00	27.071	33.5	43.0	38.3	......	......	......	......	—1.9	......	......	Calm.	Clear.	
	9 10	27.108	56.0	53.0	44.2	......	......	......	......	—2.1	......	......	Calm.	0.1.	Moved barometer out of the observatory.
	11 00	27.066	59.0	59.5	48.3	......	......	......	......	—2.1	......	......	W. 1.	0.4.	
	1 00 P. M.	27.044	64.7	61.3	50.0	......	......	......	......	—1.9	......	......	W. 1.	0.5.	6th above the Hell Gate.

Meteorological observations—Continued.

HELL GATE.

Date.	Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	WATER. River.	WATER. Creek.	GAUGE. River.	GAUGE. Creek.	Rain.	Wind.	Clouds.	Remarks.
1860. h. m.		°	°	°	°	°	°	°	*In.*					
April 12, 3 00 P. M.	27.008	73.0	62.2	51.3	83.5	68.7	48.5	48.0	—1.8	......	......	SW. 1.	0.6.	Max. black, 87°.
5 00	26.950	63.8	61.0	49.0	70.3	63.7	47.5	47.5	—1.6	......	......	W.SW. 1.	0.7.	
9 00	26.934	45.0	45.0	......	46.0	45.2	......	......	......	......	......	E. 2.	0.5.	
April 13, 5 30 A. M.	26.940	29.0	29.7	29.0	29.5	28.3	42.5	38.0	......	......	......	E. 2.	0.3.	
7 00	26.943	36.5	35.3	33.0	42.0	35.0	43.0	37.5	—1.4	......	......	E. 3.	0.1.	
10 15	26.972	66.2	51.5	45.5	74.7	60.5	46.7	42.2	—1.2	......	......	Calm.	Clear.	
1 08 P. M.	26.938	74.7	68.0	57.5	83.2	73.0	49.5	48.0	—1.2	......	......	Calm.	0.3.	
3 00	26.868	74.3	67.0	52.0	82.3	74.2	50.5	49.5	—1.2	......	......	W. 1.	0.7.	
5 00	26.798	67.0	65.0	51.5	75.0	69.0	51.0	48.7	—1.1	......	......	W. 1.	0.5.	
7 05	26.710	49.0	48.0	43.0	48.0	47.0	50.0	46.5	—0.8	......	......	E. 1.	....	
10 15	26.715	47.8	48.0	......	48.5	......	......	......	.....	......	......	E. 3.	0.7.	Eastern light.
April 14, 5 00 A. M.	26.618	33.5	33.5	32.0	33.3	32.2	45.2	39.3	—0.2	......	......	E. 3.	0.6.	
7 30	26.620	49.5	46.0	43.0	54.5	45.5	45.2	39.5	—0.1	......	......	W. 1.	0.9.	
10 00	26.609	67.0	55.7	48.0	83.0	65.2	48.2	42.5	—0.1	...	......	W. 1.	0.2.	
Noon.	26.560	70.5	67.0	56.5	86.0	76.0	50.3	46.7	0.0	......	......	W. 2.	0.5.	
2 00 P. M.	26.502	67.7	63.5	51.5	67.5	65.0	51.3	49.2	+0.2	......	......	W. 4.	0.9.	
5 00	26.441	64.7	61.5	48.2	66.2	64.0	51.8	49.3	+0.6	......	......	W. 4.	0.7.	
7 00	26.430	54.5	54.0	43.0	54.7	54.0	51.0	47.0	+0.9	......	......	W. 4.	0.8.	
April 15, 6 15 A. M.	26.484	40.0	40.0	34.3	41.0	39.0	46.2	40.5	+2.1	......	......	W. 3.	0.8.	
9 00	26.512	50.0	44.2	37.3	49.8	45.0	46.7	40.5	+2.4	......	......	W. 3.	0.9.	
Noon.	26.544	48.0	45.0	38.0	48.3	45.5	46.8	41.2	+2.9	......	......	NW. 3.	1.0.	
4 00 P. M.	26.570	46.2	44.0	37.5	46.5	44.5	47.0	42.2	+3.8	......	......	W.NW. 4.	0.8.	Hailing
7 00	26.610	40.3	38.5	35.2	40.0	38.5	47.3	43.0	+4.2	......	......	W. 2.	0.4.	
9 30	26.647	32.7	32.0	30.3	32.3	30.8	47.0	40.5	+4.4	......	......	E NE. 1.	0.9.	
April 16, 5 30 A. M.	26.710	26.8	26.0	24.3	26.3	24.4	43.8	36.2	+4.5	......	......	E. 2.	Clear.	
8 00	26.723	42.5	35.3	33.5	64.0	45.3	44.0	36.3	+4.6	......	......	SE. 1.	Clear.	
11 00	26.740	62.7	48.0	39.0	67.7	54.3	46.0	41.3	+4.9	......	......	W. 2.	Clear.	
1 00 P. M.	26.730	64.2	53.5	45.0	70.3	60.2	48.0	45.2	+5.4	......	......	W. 2.	0.1.	
4 00	26.661	55.3	55.0	45.2	59.2	55.8	48.5	46.0	+5.6	......	......	W. 1	0.7.	
7 00	26.616	49.8	48.8	39.5	50.2	49.0	48.0	44.2	+5.5	......	......	E. 3.	0.3.	
9 00	26.600	47.0	45.3	......	46.5	......	......	......	......	......	......	E NE. 4.	0.1.	
April 17, 5 45 A. M.	26.554	28.8	28.5	27.0	29.0	27.5	43.5	38.0	+5.1	......	......	E. 1.	0.7.	Stormy
8 00	26.564	45.2	40.2	38.2	60.0	45.3	43.5	38.0	+5.0	......	......	Calm.	0.6.	
Noon.	26.568	70.0	60.0	49.5	75.3	66.0	45.2	43.2	+5.1	......	......	W. 2.	0.8.	
3 00 P. M.	26.541	61.1	56.0	48.0	63.2	50.2	47.0	44.8	+5.2	......	......	NW. 2.	1.0.	

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47.2	44.0	+5.0	......	......	W. 2.	1.0.	
April 18,	6 00 A. M.	96.770	34.3	34.2	33.0	35.6	34.3	44.3	30.0	+4.9	......	0.01	W. 1.	0.9.	Rain.
	8 00	96.768	47.6	43.5	39.5	48.5	43.5	43.5	38.5	......	......	......	W. 1.	1.0.	
	10 33	96.764	48.5	48.0	40.0	50.0	47.0	45.0	39.0	......	......	......	W. 2.	....	
	0 40 P. M.	96.784	50.0	49.5	41.0	51.5	48.0	45.0	40.5	......	......	......	W. 2.	....	
	2 15	96.754	49.5	47.8	40.5	50.4	47.0	45.0	41.0	......	......	......	W. 2.	1.0.	
	5 08	96.755	48.3	47.0	39.2	48.7	46.3	46.5	42.5	+5.1	......	......	W. 1.	0.9.	
	7 00	96.734	40.0	40.0	34.7	40.5	39.3	46.5	41.8	+5.1	......	......	Calm.	0.3.	
	8 50	96.681	35.5	......	......	33.5	34.0	......	......	......	......	......	E.NE. 2.	Clear.	
April 19,	5 30 A. M.	96.686	27.2	25.5	25.0	27.2	26.0	42.7	36.0	+5.2	......	......	S. 2.	0.7.	
	7 00	96.674	35.5	30.5	29.3	51.7	35.0	49.0	35.5	+5.2	......	......	SE 1.	0.5.	
	9 00	96.674	53.0	43.0	39.5	50.0	45.0	42.5	37.0	......	......	......	Calm.	0.9.	
	11 00	96.646	62.0	47.0	......	69.0	57.0	44.0	40.0	+5.1	......	......	Calm.	1.0.	
	1 00 P. M.	96.684	62.0	61.0	52.0	67.0	61.0	46.0	43.0	......	......	......	W. 1.	1.0.	
	4 00	96.650	57.0	52.7	43.0	57.0	53.5	47.2	45.0	+5.2	......	......	W.NW. 1.	0.7.	
	7 00	96.650	46.0	45.5	40.0	46.2	44.5	47.2	43.5	+5.1	......	......	Calm.	0.8.	
	10 00	96.674	35.6	......	......	52.5	31.5	......	......	......	......	......	E. 2.	Clear.	
April 20,	7 00 A. M.	96.762	37.0	37.0	33.5	38.0	36.0	43.0	37.3	+5.1	......	......	E. 2.	0.9.	
	9 15	96.790	54.7	47.5	41.3	62.2	50.0	43.5	39.0	+5.0	......	......	E. 1.	0.8.	
	11 05	96.786	66.3	55.2	43.5	74.2	67.3	45.5	42.5	+5.1	......	......	S.W. 1.	0.3.	
	1 00 P. M.	96.780	64.6	56.0	43.7	64.0	59.3	47.0	45.5	+5.0	......	......	S.W. 1.	0.9.	
	3 00	96.774	63.5	56.5	44.3	65.2	60.2	48.5	46.5	+5.0	......	......	W. 2.	0.9.	
	5 00	96.750	57.8	55.0	44.0	60.7	57.0	48.2	47.0	+5.0	......	......	W. 2.	0.2.	
	7 00	96.740	46.8	46.0	39.5	46.3	45.2	47.3	43.5	+5.0	......	......	W.NW. 3.	0.2.	
	8 40	96.745	44.0	......	......	43.7	43.0	......	......	......	......	......	S. 1.	0.5.	
April 21,	6 00 A. M.	96.762	38.0	34.7	34.5	35.0	35.0	44.5	38.7	+4.9	......	0.14	N. 1.	1.0.	Rain
	8 00	96.827	44.2	40.0	38.5	42.2	40.3	48.5	38.7	+5.0	......	......	Calm.	1.0.	
	10 45	96.896	53.0	45.0	43.0	55.0	49.0	45.0	43.0	......	......	......	Calm.	0.6.	
	1 30 P. M.	96.818	64.2	54.2	47.0	72.7	60.3	48.3	45.7	+4.9	......	......	W. 2.	0.8.	
	4 00	96.810	50.0	48.2	43.0	50.0	48.0	49.3	47.0	+4.8	......	......	W. 3.	1.0.	
	6 00	96.806	54.7	50.0	43.5	54.0	49.5	49.5	46.0	+4.8	......	......	Calm.	0.6.	
	10 00	96.794	38.5	......	......	38.3	36.0	......	......	......	......	......	E 2.	Clear.	
April 22,	5 30 A. M.	96.868	32.5	32.0	31.0	32.2	31.0	44.5	37.8	+4.9	......	......	N. 1.	0.9.	
	7 00	96.896	38.5	37.2	35.0	41.2	36.5	44.0	38.0	+4.9	......	......	N. 1.	1.0.	
	9 00	96.926	50.5	48.5	46.0	53.0	47.0	44.0	39.5	......	......	......	Calm.	1.0.	
	11 08	96.980	54.5	49.0	44.0	58.0	53.0	45.0	41.0	......	......	......	SW. 1.	1.0.	
	1 07 P. M.	96.974	61.0	53.0	43.8	64.0	58.0	46.0	43.0	......	......	......	W. 3.	1.0.	
	3 27	96.966	55.0	[illegible]	44.5	57.0	54.0	48.0	45.5	......	......	......	W. 3.	1.0.	
	5 30	96.958	56.2	52.5	42.0	54.0	51.7	49.0	45.2	+4.9	......	......	W. 3.	0.2.	
	10 00	96.966	35.5	34.0	......	33.3	......	......	......	......	......	......	NE. 1.	0.1.	
April 23,	5 15 A. M.	96.976	24.0	22.3	......	24.0	21.0	39.0	36.5	+5.1	......	......	NE. 2.	0.5.	
	7 00	97.023	38.8	33.5	31.7	39.2	34.0	43.5	36.2	+5.4	......	......	E. 1.	0.6.	
	9 00	97.028	45.5	41.2	34.5	48.0	41.3	44.2	37.8	+5.3	......	......	Calm.	0.8.	
	11 00	97.037	62.5	50.0	34.5	72.0	54.7	45.5	40.5	+5.4	......	......	E. 1.	0.2.	
	1 10 P. M.	97.028	68.5	55.3	43.0	77.2	69.3	48.0	46.0	+5.4	......	......	S. 1.	0.5.	
	3 00	97.004	60.7	55.2	42.5	67.5	60.0	48.3	46.3	+5.3	......	......	E SE. 2.	0.7.	
	5 00	96.959	57.2	54.2	42.5	63.5	57.2	49.3	47.0	+5.1	......	......	NW. 1.	Clear.	
	6 45	96.953	50.0	47.0	37.2	49.3	45.5	48.5	45.0	+5.1	......	......	Calm.	Clear.	
	9 50	96.972	30.2	......	......	38.7	37.0	......	......	......	......	......	E 3.	Clear.	
April 24,	5 30 A. M.	97.023	28.3	27.5	26.5	27.8	26.8	43.3	36.5	+5.2	......	......	E. 3.	Clear.	
	7 00	97.038	36.3	33.8	31.5	43.5	34.5	43.5	36.3	+5.2	......	......	E. 4.	Clear.	
	9 00	97.073	54.5	43.3	37.0	69.8	51.2	44.3	38.4	+5.2	......	......	SW. 2.	Clear.	
	11 00	97.082	65.0	54.0	44.5	75.0	61.5	46.0	42.2	+5.4	......	......	SW. 1.	Clear.	

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	WATER.		GAUGE.		Rain.	Wind.	Clouds.	Remarks.
							River.	Creek.	River.	Creek.				
1860. A. m.		°	°	°	°	°	°	°	*In.*					
April 24, 1 00 P. M.	27.067	66.0	59.3	46.5	75.5	69.5	48.5	47.0	+5.4	......	......	NW. 2.	0.1.	
3 30	27.056	68.5	61.2	46.0	75.5	67.5	50.5	49.4	+5.3	......	......	W. 1.	0.1.	
6 00	27.026	61.8	60.3	43.5	64.5	59.0	51.0	47.5	+5.1	......	......	W. 1.	Clear.	
8 10	26.996	48.5	46.5	39.2	47.5	46.2	50.0	45.3	+5.2	......	......	E. 2.	0.7.	
10 00	27.031	45.2	......	......	45.0	44.0	......	......	......	......	......	E. 3.	0.2.	
April 25, 5 30 A. M.	27.104	26.5	27.5	26.2	27.2	27.0	46.3	39.0	+5.4	......	......	E.NE. 1.	Clear.	
7 15	27.196	46.5	39.5	34.3	58.7	44.2	46.0	38.5	+5.4	......	......	W. 1.	Clear.	
9 00	27.145	59.8	51.5	41.5	70.5	56.5	47.0	40.0	+5.4	......	......	W.SW. 2.	0.5.	
11 15	27.164	71.0	59.3	46.0	82.7	69.2	49.9	44.0	+5.5	......	......	S. 1.	0.9.	
1 00 P. M.	27.154	70.8	63.0	46.0	75.0	67.0	50.3	47.2	+5.6	......	......	W. 2.	0.7.	
3 00	27.110	72.7	66.2	46.7	74.5	69.2	51.5	49.0	+5.5	......	......	NW. 2.	1.0.	
4 55	27.103	64.5	64.7	46.0	68.5	65.0	50.5	47.5	+5.5	......	......	E.NE. 2.	1.0.	Sun's halo.
7 25	27.066	50.0	47.0	42.5	46.5	45.0	51.3	46.5	+5.5	......	......	NW. 2.	0.7.	
9 50	27.034	45.5	42.7	40.0	43.7	43.5	49.7	44.3	+5.5	......	......	NE. 2.	Clear.	
April 26, 6 00 A. M.	27.044	35.5	34.0	33.0	34.7	34.0	47.3	38.5	+5.9	......	......	E. 3.	0.7.	
8 00	27.047	48.7	48.2	40.2	57.2	48.5	47.3	39.0	+6.1	......	......	E.SE. 2.	0.8.	
10 20	27.017	57.3	56.5	45.0	60.3	55.0	47.5	40.3	+6.2	......	......	SW. 1.	1.0.	
Noon.	26.980	60.8	62.3	46.0	66.0	62.0	48.5	49.0	+6.4	......	......	NW. 1.	0.9.	
2 00 P. M.	26.962	74.7	67.0	54.0	78.5	71.5	50.3	45.0	+6.5	......	......	NW. 1.	0.6.	
4 00	26.867	76.9	72.2	54.0	82.5	75.2	51.5	47.0	+6.6	......	......	W. 1.	0.9.	
6 10	26.860	67.0	65.0	50.5	67.5	66.0	51.5	46.5	+6.8	0.0	......	W. 1.	0.9.	First leaf.
8 00	26.868	57.3	55.2	......	56.5	56.0	......	......	......	......	......	......	0.5	
10 00	26.762	49.0	43.5	40.5	43.3	42.2	50.5	44.3	+7.1	......	......	E. 1.	0.2.	
April 27, 7 00 A. M.	26.636	44.5	45.0	41.0	45.7	43.7	46.0	40.5	+8.0	......	......	E. 3.	1.0.	
9 00	26.620	61.8	59.5	47.0	63.7	56.8	48.2	41.0	+8.2	......	......	E. 2.	1.0.	
11 00	26.530	69.5	72.0	52.5	78.5	72.0	49.5	43.0	+8.4	......	......	E.SE. 2.	1.0.	
1 00 P. M.	26.456	75.0	74.0	57.0	81.2	75.7	50.0	44.5	+8.6	......	......	SW. 1.	0.9.	
3 00	26.356	80.8	76.7	59.7	83.0	79.2	51.3	46.3	+8.8	......	......	SW. 4.	0.9.	
4 45	26.260	76.0	70.5	59.5	76.0	72.2	52.3	48.0	+9.0	......	......	W. 2.	0.5.	Between 5—6 p. m. thunder.
7 00	26.316	53.5	......	......	53.5	59.0	51.5	45.5	+9.5	......	......	W. 3.	1.0.	Storm. SW. 7.
April 28, 6 00 P. M.	26.500	33.2	33.0	30.5	31.5	31.5	46.0	36.5	12.9	9.2	0.07	SW. 3.	1.0.	Stormy night.
8 00	26.514	34.0	34.0	......	33.0	32.5	45.3	32.5	13.5	......	......	SW. 2.	1.0.	Snow; ½ inch.
9 00 P. M.	26.676	34.3	33.0	......	33.5	32.5	44.2	30.5	14.6	......	0.19	W. 4.	1.0.	Snow storm.
1 00	26.688	36.5	35.0	......	37.0	35.0	......	......	......	......	......	......	......	Snow storm.
5 00	26.636	36.7	37.0	......	37.0	36.0	43.2	30.3	15.7	......	......	NW. 2.	1.0.	Snow storm. Creek is falling.

	[illegible]	[illegible]	[illegible]	[illegible]	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	......	W. 1.	1.0.	
April 29,	6 00 A. M.	[illegible]	[illegible]	[illegible]	......	37.0	[illegible]	[illegible]	[illegible]	18.0	......	0.04	W. 1.	0.9.	During night, rain.
	8 00	26.979	49.7	49.5	39.0	44.5	40.3	42.8	36.8	18.2	......	......	W. 1.	0.9.	
	10 15	27.000	58.3	50.5	45.0	56.8	49.3	42.7	39.5	18.3	......	......	W. 1.	0.8.	
	Noon.	26.997	62.3	52.0	46.0	63.0	54.0	44.3	41.0	18.3	......	......	W. 3.	0.8.	Few drops of rain.
	2 15 P. M.	26.982	64.0	52.0	46.5	54.5	52.5	44.7	41.3	18.5	......	......	W. 3.	0.8.	
	4 10	26.987	55.0	52.3	44.0	54.9	52.5	45.5	43.5	18.6	......	......	W. 3.	0.8.	
	6 00	26.986	51.8	50.5	41.5	51.7	51.0	45.5	42.3	18.6	......	......	W. 3.	0.7.	
	8 20	26.962	44.5	43.5	38.5	42.5	41.5	45.0	41.3	......	......	......	SW. 2.	0.5.	
April 30,	1 00 A. M.	26.890	32.5	......	......	32.5	......	......	......	......	......	......	NE. 2.	0.4.	
	5 45	26.892	31.8	31.0	30.0	32.0	30.5	42.5	38.3	18.3	......	......	E. 3.	0.4.	
	8 00	26.860	49.5	42.7	39.5	64.9	50.0	42.5	37.8	18.2	......	......	N. 1.	0.4.	
	10 10	26.802	64.7	57.0	52.3	75.7	62.2	44.5	40.3	18.0	....	......	NW. 1.	0.4.	
	Noon.	26.731	72.7	65.7	55.0	77.5	69.5	46.5	43.3	17.9	......	......	NE. 3.	0.6.	Sun's halo.
	2 00 P. M.	26.646	73.0	68.0	56.0	73.0	72.5	48.2	45.0	18.2	......	......	W. 3.	0.8.	
	4 10	26.593	69.5	67.5	54.5	69.5	68.5	49.5	46.0	17.8	......	......	W. 4.	1.0.	
	6 00	26.554	64.3	63.3	47.5	64.7	63.5	49.0	45.0	......	......	......	W.SW. 3.	1.0.	
	8 00	26.515	54.3	52.3	46.3	53.2	51.5	48.5	43.7	......	......	......	E. 1.	0.8.	
May 1,	6 00 A. M.	26.506	45.0	45.5	42.0	46.7	45.5	46.5	40.3	17.8	......	0.03	W. 2.	0.9.	Rain.
	8 00	26.502	48.2	44.5	42.0	50.7	47.0	46.5	40.3	17.7	......	......	W. 3.	1.0.	Raining.
	10 00	26.676	57.5	50.0	48.0	52.8	49.0	47.0	43.0	......	......	......	W. 3.	0.8.	
	11 40	26.664	53.0	52.0	44.0	59.0	54.0	48.5	46.5	......	......	......	W. 1.	0.9.	
	2 00 P. M.	26.670	62.8	54.0	47.0	59.0	55.0	50.0	44.0	......	......	......	W. 2.	0.8.	
	4 05	26.674	62.0	55.0	44.5	62.5	58.0	50.7	45.5	18.0	......	......	NW. 3.	0.7.	
	6 25	26.648	49.3	46.0	38.7	49.3	47.3	49.5	43.5	18.2	......	......	W. 3.	0.6.	
	8 15	26.636	39.5	37.2	35.0	37.0	36.0	49.0	42.5	......	......	......	W. 1.	0.1.	
May 2,	6 15 A. M.	26.667	41.0	38.7	37.5	41.0	40.5	46.0	39.0	18.5	......	0.03	E.NE. 3.	1.0.	Raining.
	9 00	26.712	45.7	45.0	41.5	46.0	45.2	46.2	39.5	18.8	......	......	E.NE. 2.	1.0.	
	11 00	26.735	53.0	51.8	45.7	62.5	56.5	47.0	42.3	19.2	......	......	E.NE. 4.	0.5.	
	1 15 P. M.	26.768	62.4	59.5	48.5	73.5	64.5	48.3	45.5	19.3	......	......	E. 4.	0.5.	
	3 20	26.767	70.8	60.7	48.3	74.0	68.7	49.7	46.5	19.4	......	......	E. 2.	0.5.	
	5 00	26.739	63.5	60.2	49.5	67.5	62.3	50.3	46.0	19.5	......	....	W. 1.	0.1.	
	7 00	26.718	54.5	51.5	46.5	52.2	50.0	50.0	44.3	19.7	......	......	SW. 1.	0.1.	
	10 25	26.688	47.0	44.5	......	45.3	45.0	......	41.7	......	......	......	E. 1.	0.1.	
May 3,	6 20 A. M.	26.674	40.5	41.7	40.0	45.0	42.3	46.0	38.3	19.8	18.5	......	SE. 2.	0.6.	Creek gauge.
	8 20	26.667	57.3	56.3	45.0	65.3	53.0	46.5	40.0	19.9	......	......	SE. 1.	0.8.	Set at 18.5 inches.
	10 30	26.626	70.5	60.5	49.5	83.0	67.3	50.0	43.3	20.0	......	......	E. 1.	0.1.	
	Noon.	26.584	78.5	65.0	57.0	87.5	77.2	50.3	47.5	20.2	......	......	SE. 1.	Clear.	Sun's halo.
	2 10 P. M.	26.522	85.5	73.3	59.6	90.0	81.0	53.0	50.3	20.3	......	......	Calm.	0.1.	
	4 10	26.490	78.8	67.2	59.5	86.0	80.5	54.0	50.7	20.3	......	......	NW 1.	0.2.	
	6 00	26.348	75.0	73.8	59.0	77.0	73.5	54.3	49.8	20.3	......	......	S. 1.	0.6.	Thunder and lightning; few drops of rain.
May 4,	6 10 A. M.	26.348	52.5	51.0	48.0	60.0	51.5	49.0	40.5	22.0	21.5	0.04	W. 1.	1.0.	Creek rose three inches.
	8 15	26.365	54.5	52.7	49.5	57.0	53.0	50.5	41.0	22.3	......	......	E. 2.	0.5.	Raining.
	10 00	26.326	73.7	61.5	50.0	79.0	66.7	51.7	42.5	22.3	......	......	NW. 3.	0.5.	
	1 00 P. M.	26.342	62.7	58.0	50.5	60.0	58.2	53.0	44.0	23.0	......	......	NW. 4.	1.0.	Thunder and lightning.
	3 00	26.356	51.8	47.5	47.0	47.3	47.3	52.0	44.0	23.8	......	......	W. 3.	1.0.	Rain and hail.
	5 00	26.352	46.5	46.0	46.0	47.5	46.5	51.7	43.5	24.6	......	0.24	SW. 2.	1.0.	Rain and hail.
	7 00	26.360	43.5	42.0	41.7	42.5	42.0	51.2	42.5	25.6	......	......	SW. 2.	1.0.	
May 5,	8 30 A. M.	26.502	32.0	31.5	......	33.0	......	45.0	43.0	31.7	......	0.21	E. 4.	1.0.	Rain and snow storm.
	10 20	26.610	36.0	36.0	34.0	41.0	37.0	44.0	38.0	......	30.0	......	NE. 3.	1.0.	Creek rose 8.5.
	Noon.	26.633	42.5	42.0	40.5	50.0	44.3	46.0	40.0	32.5	......	......	NE. 4.	0.9.	
	2 10 P. M.	26.645	46.4	46.8	38.5	47.5	46.0	46.0	41.0	33.0	......	......	E.	1.0.	
	4 00	26.630	41.0	42.5	37.5	44.0	42.0	46.5	41.0	......	......	......	NE. 2.	1.0.	

Meteorological observations—Continued.

HELL GATE.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	WATER.		GAUGE.		Rain.	Wind.	Clouds.	Remarks.
								River.	Creek.	River.	Creek.				
1860.	A. M.		°	°	°	°	°	°	°	°	°	°			
May 5,	6 00 P. M.	26.644	39.5	36.7	35.0	40.0	39.5	45.2	40.5	33.4	30.0	......	E. 3.	1.0.	
May 6,	6 00 A. M.	26.704	30.3	30.0	27.7	30.3	30.0	42.0	36.0	33.4	28.0	......	E. 3.	1.0.	
	9 00	26.747	39 5	36.5	29.2	41.3	40.0	42.3	36.7	33.3	......	......	E.3.	1.0.	Stormy and cool; nowing.
	10 30	26.744	44.5	40.5	34.5	46.3	40.5	42.5	37.8	33.3	27.5	......	E.2.	0.6.	
	0 30 P. M.	26 752	51.3	48.5	37.5	59.2	59.5	44.5	41.7	33.2	......	......	E.1.	0.6.	
	2 00	26.747	57.7	45.3	36.5	58.2	51.2	45 0	41.3	33.1	......	......	N. 2.	0.9.	
	4 00	26.732	54.0	47.0	43.5	51.0	47.0	45.0	43.0	33.0	......	......	N. 1.	0.9.	
	6 00	26.736	48.3	46.0	36.5	47.0	44.7	44.5	41.7	33.0	......	......	N. 1.	0.3.	
	8 14	26.716	34.0	33.0	32.0	34.0	32.0	......	39.0	33 0	......	......	N. 1.	Clear.	
May 7,	6 00 A. M.	26.786	35.0	34.3	30.5	35.0	34.0	42.0	36.5	32.6	25.7	......	NW.1.	0.3.	Min. 30.5.
	8 00	26.808	49.0	40.2	38.0	58.7	47.5	42.3	38.9	32.2	......	......	W.2.	0.1.	
	10 00	26.824	57.5	48.5	42.0	70.3	56.5	43.5	40.3	31.8	......	......	W.2.	0.2.	
	0 10 P. M.	26.814	56.5	52.5	44.5	57.5	55.3	45.0	44.5	31.8	24.0	......	W.2.	0.6.	
	2 00	26.814	58.0	52.0	43.0	54.3	53.8	45.0	43.0	31.6	......	......	W.2.	1.0.	
	4 00	26.822	57.2	53.0	42.5	54.5	53.3	45.2	42.0	31.4	......	......	W.3.	1.0.	
	6 00	26.836	53.0	50.0	41.0	51.0	50.5	45.0	41.5	31.2	23.5	......	W.2.	1.0.	
	8 00	26.838	47.0	46.5	39 0	47.0	45.0	44.0	40 5	......	......	......	W.1.	1.0.	
May 8,	6 26 A. M.	26.852	45.5	44.7	39 3	46.0	45.0	44.0	41.5	29.7	23.5	......	W.1.	1.0.	
	8 53	26.903	48.3	47.5	42.0	49.0	47.0	44.0	39.0	......	......	......	W.1.	1.0.	
	11 05	26.900	50.8	48.8	42 8	50.0	48.8	44.0	39.0	......	....	......	W.3.	1.0.	
	1 00 P. M.	26.900	56.5	53.0	46.0	56.5	53.5	44.5	41.0	......	......	......	W.1.	1.0.	
	3 05	26.904	59.0	53.7	43.3	56.5	56.0	44.7	43.5	29.3	23.0	......	W.4.	0.9.	
	5 00	26.898	58.8	49.5	43.5	50.0	49.5	44.0	41.0	......	......	......	W.3.	1.0.	
	8 20	26.884	46.5	......	......	45.0	45.0	......	......	......	......	......	W.2.	1.0.	
May 9,	5 30 A. M.	26.818	45.8	45.0	42.3	46.0	45.0	44 0	39.5	27.8	......	......	SW. 1.	1.0.	
	7 20	26.770	47.0	46.0	43 5	46.8	45.5	43.5	39.0	......	......	......	W.1.	1.0.	
	9 30	26.794	55.8	56.3	50.0	60.0	55.0	44.0	40.0	27.5	......	......	W.1.	1.0.	
	11 00	26 794	57.4	55.5	48.5	59.0	56.0	44.3	40.5	......	......	......	W.2.	1.0.	
	1 00 P. M.	26.670	65.0	61.0	50.0	69.0	64.0	45.5	42.0	......	......	......	SW. 3.	1.0.	
	3 00	26.624	63.5	61 0	51.0	65.0	63.0	46.0	43.0	......	......	......	W.4.	1.0.	
	5 00	26.562	61.6	59.8	50.0	61.5	60.0	46.0	43.0	......	......	......	W.3.	1.0.	
	8 30	26.568	59.8	47.5	......	47.5	......	......	.....	......	......	0.05	Calm.	1.0.	Raining.

Meteorological observations—Continued.

MILITARY ROAD.

Date.	Station or camp.	Distance.	Barometer.	Attached.	Rain.	Wind.	Clouds.	Remarks.
1860. A. m.		*Miles.*		°				
May 10, 4 45 A. M.	Hell Gate Observatory	0	26.593	44.3	......	....	....	Six feet above water.
6 15	.... do........do	0	26.524	45.8	0.03	SW. 2.	Nimb. 1.0.	
4 00 P. M.	Big Blackfoot, 1st camp	13	26.365	52.8	......	W. 3.	Nimb. 0.8.	13 feet above water.
7 00	.... do........do	13	26.319	46.0	......	W. 2.	0.8.	
May 11, 5 30 A. M.	......do........do	13	26.183	39.4	......	SW. 2.	0.8.	
8 30	Top of 1st Big Side spur*	....	25.440	48.0	......	....	....	* Divide to the left from 200 to 300 feet lower.
9 40	Top of 2d Big Side spur	....	25.522	53.2	......	....	....	
	Big Blackfoot, 2d camp	27	.....	......	......	NW. 5.	....	Rain, snow and hail.
May 12, 3 30 P. M.	Big Blackfoot, 3d camp	44	25.772	43.3	......	NW. 4.	1.0.	Camp on second big creek.
6 00	......do........do	44	25.869	38.0	0.03	NW. 4.	1.0.	Rain and snow during night.
May 13, 7 00 A. M.	.... do........do	44	26.102	39.8	.....	W. 3.	0.3.	
11 00	Third big creek	53	25.992	42.0	......	....	....	
3 30 P. M.	Stevens' prairie, 4th camp	60	25.817	45.0	.....	....	....	
5 50	......do........do	60	25.832	40.0	......	W. 4.	0.9.	
7 50	......do........do	60	25.842	29.8	.....	Calm.	0.1.	
May 14, 5 30 A. M.	......do........do	60	25.858	23.7	......	W. 1.	0.8.	
6 40	......do........do	60	25.918	42.0	......	S. 1.	0.1.	
4 45 P. M.	Between two creeks close together	79	25.550	49.3	......	E. 2.	1.0.	Fifth camp.
7 00	......do........do	79	25.538	43.8	......	S. 3.	0.4.	
May 15, 6 45 A. M.	......do........do	79	25.580	36.3	.....	NE. 3.	1.0.	
9 14	Crossing of Lander's fork	....	25.432	38.7	......	....	....	
11 00	¼ mile above in the woods	85	25.390	42.5	.....	....	....	Sixth camp, sheltered five feet above creek.
1 00 P. M.	......do........do	85	25.430	44.0	......	....	....	Went with Mr. Sohon on Louis and Clark's Pass.
3 00	......do........do	85	25.438	40.0	......	....	....	
5 36	......do........do	85	25.408	37.0	......	....	....	
7 14	......do........do	85	25.458	31.5	0.04	....	....	Strong easterly wind on open ground; found ½ inch of new snow on the pass, 15 miles from camp.
May 16, 5 25 A. M.	..... do........do	85	25.510	.....	......	....	....	
6 45	..... do........do	85	25.516	34.0	......	....	....	
11 30	Cadotte's Pass, west foot.	99.0	24.768	44.0	......	E. 2.	1.0.	No old snow on the western side, but 5 to 7 feet of old snow on the eastern side.
Noon.	Cadotte's Pass, top	99.3	24.301	41.2	.....	....	....	
1 00 P. M.	Cadotte's Pass, east foot	100.5	25.437	45.3	......	....	....	
4 40	Louis and Clark's creek, 7th camp	106	25.935	53.2	......	E. 2.	0.2.	Cadotte's Pass being more open to the sun and wind, is better adopted for crossing early in spring.
6 30	......do........do	106	25.900	44.7	......	Calm.	0.1.	
7 50	......do........do	106	25.882	46.8	......	Calm.	0.9.	
May 17, 5 00 A. M.	......do........do	106	25.796	31.8	......	Calm.	....	Dew.

Meteorological observations—Continued.

MILITARY ROAD.

Date.		Station or camp.	Distance.	Barometer.	Attached.	Rain.	Wind.	Clouds.	Remarks.
1859.	h. m.		*Miles.*		°				
May 17,	6 00 A. M.	Seventh camp	106	25.800	40.5	......	Calm.	....	
	1 45 P. M.	Eighth camp	122	26.063	75.0	......	NE. 2.	Cir. 0.3.	On Biber creek.
	5 30	......do......do	122	26.003	70.3	......	E. 3.	Cir. 0.3.	
	6 10	......do......do	122	25.999	66.5	......	Calm.	Cir. 0.2.	
May 18,	6 00 A. M.	......do......do	122	25.892	63.5	......	Calm.	Clear	
	6 10 P. M.	Ninth camp	141	26.122	79.8	......	E. 3.	Clear	At Father Oken's place the temperature of the air registered, for comparison, 80.5, 70.9, 53.8, respectively.
	7 30	......do......do	141	26.088	70.8	......	E. 3.	Clear	
May 19,	6 15 A. M.	......do......do	141	26.064	56.0	......	E.NE. 4.	Stra. 1.0.	
	6 30	......do......do	141	26.065	......	......	......	......	
	1 00 P. M.	Sun river farm	......	26.319	67.0	......	......	......	10 feet above water.
	4 00	Tenth camp	161	26.367	54.5	0.05	N. 3.	Nimb. 1.0.	Road leaving Sun river.
	6 40	......do......do	161	26.345	47.5	......	Calm.	Nimb. 1.0.	
May 20,	6 00 A. M.	......do......do	161	26.266	42.0	......	W. 3.	Nimb. 1.0.	
		Eleventh camp, springs	163	......	......	0.33	NW. 7.	Nimb. 1.0.	Very bad weather.
May 21,	3 00 P. M.	Fort Benton	200	......	......	......	......	......	Traveller! carry wood and tent poles on the eastern side of the Rocky mountains.
May 22,	......	......do......do	......	......	......	......	......	......	Weather warmer.
May 23,	Noon.	......do......do	......	27.196	58.0	......	E.NE. 4.	1.0.	Weather very warm.

NOTE.—The aneroid was put at the Bitter Root in care of Mr. Kolecki to make readings for a profile from the Bitter Root to Fort Benton.

Meteorological observations—Continued.

FORT BENTON.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Water.	Gauge.	Rain.	Wind.	Clouds.	Remarks.
1860.	A. M.		°	°	°	°	°	°	In.				
May 23,	0 25 P. M.	27.198	56.0	58.5	55.0	62.8	59.5	56.0	2.6	......	E.NE. 4.	Nimb. 1.0.	Water level at noon, May 22, assumed to be zero.
	5 40	27.198	54.7	54.5	50.5	55.8	54.8	56.3	2.9	0.02	E. 6.	Str. 1.0.	Rainy.
May 24,	6 40 A. M.	27.157	47.7	47.3	45.2	48.0	47.0	55.2	2.6	......	E. 4.	Str. 1.0.	Rainy.
	11 00	27.119	46.3	46.0	44.5	47.0	46.5	54.3	3.2	......	E 3.	Str. 1.0.	Rainy.
	3 00 P. M.	27.106	50.0	50.0	48.0	52.0	49.0	54.7	4.6	......	W.SW. 4.	Str. 1.0.	Rainy.
	6 15	27.092	45.5	45.9	44.0	44.0	44.0	53.3	4.7	0.63	W.SW. 5.	Str. 1.0.	Rainy.
May 25,	6 15 A. M.	27.110	46.5	48.0	46.5	48.0	48.0	52.3	5.4	......	W.SW. 4.	Str. 1.0.	Cistern of the barometer 12 feet above water.
	8 27	27.199	58.0	57.8	50.0	66.0	60.5	54.0	......	......	W. 4.	0.6.	
	11 08	27.180	65.0	64.5	55.0	75.0	63.5	55.5	6.3	......	SW. 6.	0.6.	
	1 00 P. M.	27.164	64.5	69.0	58.5	74.5	70.0	59.3	6.5	......	W.SW. 6.	0.8.	
	3 05	27.150	69.0	68.8	56.0	77.5	70.5	56.5	......	......	W.SW. 6.	0.7.	
	5 00	27.138	68.0	66.5	57.5	74.5	60.3	58.0	6.4	......	W.SW. 5.	0.4.	
	8 40	27.114	56.0	55.0	51.0	54.0	54.0	54.0	......	......	W. 2.	Clear.	
May 26,	6 20 A. M.	27.118	54.7	54.7	49.5	55.3	54.5	52.0	7.3	......	W.SW. 4.	0.7.	
	8 00	27.119	63.0	63.2	53.3	68.0	64.5	55.0	7.5	......	SW. 7.	1.0.	
	10 15	27.108	61.0	60.8	52.4	64.5	61.0	53.0	......	......	W.SW. 7.	1.0.	
	3 00 P. M.	27.116	64.0	64.0	53.3	69.0	64.5	54.3	8.2	......	W.NW. 7.	1.0.	
	5 00	27.195	61.7	61.7	51.0	64.5	60.5	53.3	8.4	......	NW. 6.	1.0.	
	7 20	27.210	54.8	54.4	50.8	53.5	53.0	51.8	......	......	W.NW. 3.	1.0.	
May 27,	5 20 A. M.	27.246	45.8	46.0	44.7	46.8	45.7	50.7	11.0	......	NE. 1.	1.0.	
	7 20	27.242	50.5	51.5	50.4	58.5	51.5	58.0	......	......	E. 1.	0.9.	
	9 15	27.272	63.0	61.5	53.2	91.3	70.5	56.5	11.2	......	E.SE. 1.	1.0.	
	11 15	27.276	60.5	61.8	51.2	83.7	71.0	55.7	11.4	......	E.NE. 2.	0.9.	
	2 00 P. M.	27.236	65.5	66.0	55.5	76.7	67.5	56.7	11.5	......	NE. 2.	0.7.	
	4 00	27.226	60.5	60.0	52.0	66.2	62.0	53.0	11.6	......	E. 2.	0.6.	
	6 00	27.248	59.8	60.0	53.0	66.0	61.2	55.3	11.7	......	E. 2.	0.4.	
	8 20	27.236	52.5	51.0	47.5	48.5	48.0	53.3	11.8	......	NE. 2.	0.1.	
May 28,	4 50 A. M.	27.272	36.5	36.0	35.5	36.0	35.5	51.5	11.4	......	S. 1.	Clear.	
	7 40	27.340	53.5	53.5	49.5	104.0	88.5	55.0	11.4	......	S. 1.	Clear.	
	10 00	27.380	64.0	64.5	51.0	94.0	77.0	59.0	11.3	......	SE. 3.	0.4.	
	Noon.	27.381	64.5	64.5	53.0	78.0	69.7	58.3	11.1	......	E.NE. 3.	0.7.	
	2 30 P. M.	27.349	72.7	59.0	55.0	80.0	71.5	62.0	11.0	......	NE. 3.	0.2.	
	5 05	27.330	68.5	65.0	53.5	94.0	80.5	57.5	11.0	......	E.SE. 3.	0.6.	
	8 00	27.322	59.8	55.0	49.5	55.5	55.4	55.2	11.0	......	E.NE. 3.	0.2.	
	9 30	27.306	54.0	......	......	53.0	......	......	......	......	E. 3.	0.2.	

Meteorological observations—Continued.

FORT BENTON.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Water.	Gauge.	Rain.	Wind.	Clouds.	Remarks.
1860.	h. m.	°	°	°	°	°	°	°	*In.*				
May 29,	4 30 A. M.	27.296	49.0	41.0	39.5	40.0	40.0	55 0	10 1	......	S. 1.	0.1.	
	6 30	27.302	65.0	49.6	46.7	94.0	81.0	56.0	10.1	......	S. 1.	0.2.	
	8 00	27.286	59.7	57.3	52.5	110.0	93.0	58.0	10.0	......	Calm.	0.1.	
	10 00	27.279	66.0	68.0	56.4	102.5	80.8	63.0	......	......	E. 2.	Clear.	
	Noon.	27.283	76.0	78.5	58.0	110.5	95.3	63.4	9.7	......	N. 1.	0.1.	
	2 15 P. M.	27.264	81.0	75.0	57.5	101 5	96 0	62.5	9.5	......	E. 2.	0.2.	
	4 00	27.276	83.3	72 5	57.5	107 0	93 0	61.7	9.3	......	E.SE. 1.	0.3.	
	6 10	27.261	70.7	69.0	54.5	72.5	69.5	59.0	9.0	......	E.SE 3.	0.7.	
	9 45	27.247	61.0	60.3		......	60 5	......	......	......	E.SE. 6.	0.2.	
May 30,	5 10 A. M.	27.233	53.5	53.3	47.5	53.5	53.2	57.0	8.4	......	SE 2.	0.8.	
	7 00	27.236	62.2	65.0	52 5	67.0	65.5	56.5	8.2	......	E. 3.	0.6.	
	9 00	27.241	70.5	67.0	56.0	78.7	70.0	60.0	8.0	......	E. 4.	0.7.	
	11 15	27.224	73.0	71.5	56.5	79.0	73.0	61.0	......	......	E. 5.	0.6.	
	1 30 P. M.	27.209	76.0	76.7	62 0	82.0	77.0	63 0	7.8	......	SE. 5.	0 6.	
	4 15	27.212	64.5	61.0	58.5	64.0	61.5	63.5	......	0.01	S. 6.	1.0.	
	6 12	27.188	64.8	64.5	58 0	66.0	64.5	59.8	......	......	W.SW. 1.	1.0.	
	8 30	27.188	60.5	60.2	56.0	61.0	60.3	59.0	7.5	......	W. 3.	1.0.	
May 31,	5 20 A. M.	27.162	49 8	49.5	48.7	49.5	49.2	58 2	7.0	0.01	NW. 2.	0.5.	
	7 00	27.168	61.5	58.0	54.5	66.0	59.0	59.5	7.0	......	W. 3.	0.2.	
	9 40	27.184	77.7	66 0	58.0	93.0	73.0	63.0	......	......	W. 2.	0 2.	
	Noon.	27.144	78.5	79.0	61.0	112.0	88.0	66.0	7.0	......	SW. 2.	0.4.	
	2 00 P. M.	27.106	77.5	74.0	61.0	90.5	79.0	65 0	7.1	......	SW. 2.	0.8.	
	4 25	27.076	71.0	70.0	59.0	71.0	70.8	63.0	......	......	SW. 3.	1.0.	
	6 05	27.054	67.8	67.0	58.5	68.0	67 0	61.0	7.4	......	SW. 3.	1.0.	
	9 55	27.038	60.0	57.0	55.5	57.5	57.0	......	......	......	W.SW. 2.	0.8.	
	11 00	27.028	56.5	56.0	54.5	57 0	56.5	......	....	......	SW. 2.	1.0.	Rain.
June 1,	6 00 A. M.	27.010	56 5	56 0	54.7	57.0	56.5	60.3	9.9	......	SW. 1.	1.0.	Rain.
	8 30	27.007	58.8	59.8	57.5	62.5	58.0	60.5	10.4	......	Calm.	1.0.	Rain
	11 00	26.994	63.0	63.0	59.0	72.5	65.5	64.0	......	0.13	E.SE. 1.	1.0.	Rain.
	1 00 P. M.	26.968	70 7	66.0	60.5	113.5	79 0	64.7	10.9	......	NE 2.	0.7.	
	3 00	26.966	69.6	65.3	58.3	73.0	67.7	62.3	11.4	......	W. 2.	1 0.	Thunder.
	5 00	26.947	63.0	63.5	57.5	70.3	64.0	62.0	11.6	......	NE. 1.	0.9.	
	7 15	26 976	65.8	66.8	59.0	68.0	67.0	60.5	......	......	Calm.	1.0.	
June 2,	6 00 A. M.	26 976	55.2	55.0	53.3	56.0	54.7	59.0	13.3	......	W. 3.	1.0.	Rain.
	8 00	26.976	58.8	59.2	56.3	57.5	55.5	60.5	13.8	......	W. 3.	0.9.	Rain.

	12 27	[illegible]	63.2	65.5	57.0	69.5	64.5	61.5	......	......	S.SW. 2.	1.0.	Rain and thunder.
	0 55 P. M.	[illegible]	64.0	64.0	56.0	69.4	64.5	63.2	14.8	0.07	W. 1.	1.0.	
	2 20	97.000	68.5	68.8	58.0	77.0	69.0	65.5	15.3	......	W. 3.	0.8.	
	4 25	96.992	74.8	75.5	59.0	85.0	76.0	63.0	15.8	......	W. 3.	0.8.	
	6 25	97.006	56.0	56.0	55.0	54.0	54.0	59.0	16.2	......	W. 1.	1.0.	
June 3,	5 15 A. M.	97.020	52.8	52.3	51.0	51.0	51.0	57.5	19.3	0.16	W. 3.	0.5.	Rain.
	7 00	97.078	57.2	57.0	55.5	58.8	54.0	58.0	19.6	......	E.NE. 3.	0.9.	
	9 00	97.122	61.3	61.0	56.0	70.5	59.5	61.0	20.0	......	E. 2.	0.6.	
	11 00	97.136	70.5	71.0	59.0	101.5	78.0	66.0	......	......	E. 2.	0.4.	
	1 00 P. M.	97.148	74.0	74.0	63.0	98.5	76.0	68.0	21.0	......	NE. 2.	0.4.	
	3 05	97.152	72.8	73.0	63.5	81.5	73.0	67.0	21.4	......	NW. 3.	0.6.	
	5 00	97.164	74.0	74.5	60.0	82.5	73.0	64.0	21.8	......	W.NW. 2.	0.5.	
	7 00	97.172	63.0	63.0	58.0	60.0	60.6	59.0	22.4	......	W.SW. 2.	0.7.	Rainy.
June 4,	Midnight.	97.228	55.8	55.0	52.4	51.5	51.0	58.2	23.2	......	N. 1.	0.4.	
	2 00 A. M.	97.225	52.3	52.0	50.5	49.5	49.0	57.5	23.4	......	N. 1.	0.3.	
	5 30	97.292	57.2	57.8	55.7	58.5	56.0	57.0	24.2	......	SW. 1.	0.9.	Rainy.
	8 00	97.322	62.8	63.4	58.5	69.3	62.3	57.8	24.8	0.01	NW. 3.	1.0.	
	10 10	97.319	62.3	62.2	59.3	62.5	62.0	57.5	25.6	......	N.NE. 2.	1.0.	
	Noon.	97.312	63.0	63.0	59.0	67.0	64.5	56.8	26.1	......	NE. 4.	1.0.	Rain.
	2 00 P. M.	97.306	61.8	61.3	59.0	61.0	61.0	59.0	......	0.07	NE. 1.	1.0.	Rain.
	4 25	97.292	66.8	67.0	61.0	78.8	70.5	57.5	......	......	W.SW. 1.	0.6.	
	7 30	97.294	63.0	63.6	53.0	61.0	61.0	57.0	28.1	......	NE. 2.	0.3.	
	8 45	97.326	55.5	55.0	49.7	51.5	51.5	56.7	28.5	......	NE. 2.	0.2.	
June 5,	0 45 A. M.	97.298	47.5	46.5	45.0	42.0	42.0	54.0	......	......	W. 1.	0.1.	
	3 00	97.290	44.5	45.5	44.0	42.3	......	54.7	29.8	......	Calm.	0.8.	
	6 15	97.342	53.0	54.0	51.5	53.5	51.0	55.3	30.8	......	W. 2.	0.3.	
	8 00	97.348	61.5	62.0	57.0	69.8	62.3	57.3	31.9	......	W. 3.	0.1.	
	10 30	97.346	71.0	71.5	......	......	......	......	......	......	......	......	
	11 00	97.326	72.0	71.8	59.7	96.0	76.3	61.2	33.0	......	NW. 4.	0.4.	
	1 00 P. M.	97.333	77.3	78.0	61.5	92.5	81.0	59.5	33.6	......	W.NW. 4.	0.5.	
	3 00	97.290	75.0	75.0	61.5	74.5	74.0	60.0	......	......	W.NW. 3.	0.9.	
	5 05	97.244	77.0	77.0	60.5	80.0	77.5	59.3	35.1	......	W.NW. 3.	0.4.	
	7 00	97.230	68.5	68.5	58.5	69.5	68.5	57.5	35.7	......	W.NW. 2.	0.8.	
	9 00	97.226	60.0	59.2	56.0	57.0	57.0	57.3	36.3	......	SW. 2.	0.7.	
June 6,	5 35 A. M.	97.124	59.5	60.0	56.5	59.5	60.0	55.0	37.8	0.03	SW. 1.	1.0.	Rain.
	7 10	97.110	60.5	60.5	56.5	66.0	61.0	56.0	......	......	S. 1.	1.0.	
	9 25	97.140	71.0	73.0	63.5	93.0	75.0	57.5	38.2	......	Calm.	0.8.	
	11 10	97.116	75.0	76.0	65.5	92.0	77.0	58.0	38.5	......	SW. 1.	0.8.	Sun's halo.
	1 00 P. M.	97.070	82.5	85.0	67.5	98.5	86.8	59.0	38.7	......	Calm.	0.6.	Max. black 103.0.
	3 00	97.019	73.0	73.8	61.5	76.0	73.5	58.2	38.8	......	E. 3.	0.8.	Thunder.
	5 12	96.996	69.0	69.0	61.5	70.8	69.8	58.0	38.9	......	S.SW. 3.	1.0.	
	7 05	96.990	64.0	64.0	56.5	64.5	64.0	57.5	39.0	......	S.SW. 3.	1.0.	
June 7,	3 40 A. M.	96.998	53.0	52.8	48.5	48.5	47.7	55.2	38.5	......	E. 2.	0.3.	
	5 30	97.036	53.0	52.6	51.5	53.3	52.0	55.0	38.3	......	W. 1.	1.0.	
	7 10	97.062	56.5	56.5	51.5	59.4	56.0	55.0	......	......	E.SE. 3.	1.0.	
	9 00	97.100	59.0	58.5	52.0	62.8	59.0	55.4	38.3	......	E.SE. 3.	1.0.	
	11 12	97.158	62.8	62.5	53.5	63.5	63.0	56.0	......	0.01	E.SE. 3.	1.0.	Rainy.
	1 20 P. M.	97.196	64.5	64.3	54.0	65.0	64.5	56.0	38.5	......	E. 5.	1.0.	
	3 10	97.212	68.5	69.3	56.2	77.0	74.5	58.2	38.6	......	E. 7.	0.6.	
	5 05	97.232	67.7	67.3	58.0	69.0	68.0	57.0	38.7	......	E. 4.	0.5.	
	7 05	97.284	64.8	64.4	54.5	65.0	64.5	56.0	......	......	E. 5.	0.5.	
	8 30	97.321	61.3	61.0	50.0	61.5	61.2	56.5	38.7	......	E. 4.	0.3.	
June 8,	3 40 A. M.	97.378	52.0	52.0	48.0	50.0	51.5	56.2	38.5	......	E. 4.	0.4.	Dew.

Meteorological observations—Continued.

FORT BENTON.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Water.	Gauge.	Rain.	Wind.	Clouds.	Remarks.
1860.	h. m.		°	°	°	°	°	°	*In.*				
June 8,	5 45 A. M.	27.424	55.8	55.5	49.0	58.0	55.8	56 0	38.5	......	E. 2.	0.6.	
	7 15	27.436	58 3	58.0	52.0	60.0	59.0	56.0	......	......	E. 3.	0.6.	
	9 10	27.454	65.8	65.4	56.5	77.0	67.0	58.5	38.8	......	E 3.	0 3.	
	11 00	27.442	68.0	68.0	58.5	70.0	69 0	59.4	39.1	.....	SE. 5.	0.3.	
	1 00 P. M.	27.423	65 7	66.4	56 5	72.5	66.0	59.0	39.3	.....	E. 6.	0 9.	
	3 10	27.401	58.8	58 8	55.2	59.2	58.5	58.9	39.5	......	E. 5.	1.0.	Rain.
	5 30	27.386	58.5	58.5	56.0	58.8	58.0	57.0	39.8	0.03	E. 2.	1.0.	Rain.
	7 05	27.386	59.0	59.0	55.0	59.0	58.5	57 0	39.9	.....	E. 2.	1.0.	
	8 00	27.375	58.7	58.3	54.3	59 0	58.0	57.3	39.9	......	E. 2.	1.0.	
June 9,	3 45 A. M.	27.984	54 5	54 0	50.7	55.0	54.2	56.0	40.2	.....	E. 3.	0.2.	
	5 30	27.984	58.0	58.0	54.0	59.5	59.0	55.5	40.3	.....	E NE. 1.	0.3.	
	7 00	27.984	58.3	58.0	54.5	63 5	60.0	56.0	......	......	E. 2.	0.3.	
	9 08	27.270	63.0	63.0	57.0	71 0	64.5	57.0	......	......	E. 4.	0.4.	
	11 00	27.262	73.0	75.5	65.0	106.0	82.0	59.0	40.5	......	E. 2.	0.6.	Rainy.
	4 00 P. M.	27.192	72.5	74.5	61.5	76 5	71.5	58.6	41.1	......	E. 1.	0.4.	
	6 00	27.177	70.2	71 2	61.0	70.0	69.8	58 4	41.3	.....	SE. 2.	0.2.	
	9 00	27.144	60.0	59.0	56.2	54.8	54.5	58.8	41.4	......	N. 1.	0.3.	
June 10,	3 10 A. M.	27.090	51.0	50.3	49.5	46.7	......	57.0	41.4	......	N NW. 1.	0.2.	
	5 00	27.100	49.0	48.3	47.0	46.3	46.3	57.5	41.4	......	N. 1.	0.2.	
	7 10	27.134	66.0	67.0	60.0	79.0	69.0	58.8	......	......	SW. 1.	0.1.	
	9 00	27.116	72.3	72.8	61.5	87.0	74.0	59.0	41.0	......	S SW. 1.	0.1.	
	11 00	27.116	79.8	81.8	62.5	107.8	84.0	61.0	40.8	......	W. 2.	0.5.	
	1 30 P. M.	27.084	81.8	83.3	66.0	96.0	81.7	60.7	40.5	......	W 5.	0.8.	
	3 50	27.104	72.0	76.8	68.0	76.0	75.0	61.0	40.5	......	NW. 1.	0.9.	Thunder and lightning.
	5 25	27.034	69 8	70.5	61.5	70.0	70.0	60.0	40.4	......	SW. 3.	0.9.	
	7 50	27.120	59.5	59.0	54.5	......	......	59.5	40.2	.....	W. 5.	1.0.	
June 11,	3 00 A. M.	27.068	52.5	53.0	51.2	49.2	50.8	58.0	39.8	0.04	NW. 1.	0.8.	Rain.
	5 10	27.106	54.3	54.0	52.5	54 0	53.0	58 0	39.6	.....	NW. 2.	0.9.	
	7 00	27.150	60.5	60 0	55.5	73.0	62.5	58.0	39 6	......	W. 3.	0.9.	Raining
	9 00	27.154	64.8	65.0	59.0	88.0	68.0	60 0	......	......	SW. 2.	1.0.	
	11 00	27.174	69.0	70.8	63.0	108.5	77.0	60.7	39.8	......	W. 2.	0.3.	
	1 25 P. M.	27.164	76.0	79.0	66.5	101.0	88.3	61.5	39.9	......	N. 2.	0.2.	
	4 50	27.118	76.0	79.5	67.0	97.5	78.5	61.5	40.0	......	W. 2.	0.2.	
	6 20	27.104	73.5	74.0	69.5	77.5	76.0	60.0	39.9	......	NW. 1.	0.3.	Thunder storm, west S.
	8 20	27.116	66.5	64.5	60.5	......	......	......	......	......	W. 1.	1.0.	Rain.

June 12,	5 00 A. M.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.0.	
	7 00	[illegible]	[illegible]	[illegible]	50.5	[illegible]	51.5	[illegible]	40.1	......	W.NW. 1.	1.0.	
	9 00	27.304	54.5	54.5	51.5	56.0	54.0	58.5	40.1	......	W.NW. 2.	1.0.	
	11 00	27.308	61.0	62.0	55.5	79.0	64 0	59.0	......	......	W.NW. 1.	0.9.	
	1 00 P. M.	27.292	64.5	64.5	57.5	75.5	65.0	60.0	......	......	W. 1.	0.9.	
	3 20	27.306	68.0	70.5	59.5	72.0	67.0	61.0	40.5	......	E. 1.	0.5.	
	5 00	27.268	67.5	69.5	59.0	74.5	72.0	60.0	40.7	......	E. 3.	0.3.	
	7 05	27.242	63.5	63.5	56.5	65.0	64.5	59.0	40.5	......	E. 2.	0.5.	Rain and thunder
June 13,	5 40 A. M.	27.288	54.2	54.5	53.0	53.0	53.0	58.7	40.4	0.16	E. 2.	1.0.	Rain.
	7 10	27.324	51.0	49.0	48.0	48.0	49.0	57.5	......	......	NE. 1.	1.0.	Rain.
	9 25	27.356	48.0	47.3	46.5	47.5	46.5	57.4	......	......	NW. 2.	1.0.	Rain.
	11 25	27.374	51.5	51.0	50.0	57.0	50.8	58.0	40.2	......	NW. 2.	1.0.	Rain.
	1 20 P. M.	27.368	52.0	52.0	50.0	55.0	51.0	57.0	......	......	NW. 2.	1.0.	Rain.
	3 20	27.330	52.3	52.8	50.5	54.9	51.5	57.0	......	......	NW. 2.	1.0.	Rain.
	5 45	27.332	52.5	52.3	50.5	52.0	51.5	56.5	40.3	......	SW. 2.	1.0.	Rain.
	8 45	27.396	51.8	51.0	50.0	......	......	......	......	0.55	SW. 2.	1.0.	Rain.
June 14,	6 05 A. M.	27.354	49.0	49.0	48.0	51.0	50.0	56.0	40.5	......	SW. 2.	1.0.	
	8 00	27.356	54.0	53.5	52.0	72.5	56.0	56.8	......	......	SW. 2.	1.0.	
	10 00	27.400	63.5	63.0	58.0	104.0	74.0	59.0	......	......	SW. 2.	0.6.	
	Noon.	27.420	72.0	73.5	63.5	106.5	85.0	61.0	41.0	......	SW. 1.	0.5.	
	2 00 P. M.	27.446	75.0	80.0	64.0	85.0	75.5	61.0	......	......	W. 1.	0.3.	
	4 00	27.412	76.5	81.5	63.5	90.0	86.0	60.0	41.5	......	W. 1.	0.3.	
	6 00	27.392	70.5	73.0	62.0	71.5	70.5	59.5	41.5	......	NE. 2.	0.5.	
	7 40	27.378	65.0	65.0	59.5	64.8	64.5	58.5	41.6	......	E. 1.	0.8.	Rain, thunder, and lightning.
June 15,	5 35 A. M.	27.372	56.0	56.0	54.6	58.0	56.0	57.0	41.8	0.03	W.SW. 1.	1.0.	
	7 00	27.378	58.0	57.8	56.0	62.0	57.0	57.5	......	......	W.SW. 1.	1.0.	
	9 00	27.378	69.5	69.8	63.5	118.5	96.0	61.0	......	......	SW. 1.	0.1.	
	11 00	27.370	76.0	78.0	66.5	81.0	78.0	61.0	41.8	......	E. 1.	0.1.	
	1 00 P. M.	27.320	74.0	74.5	64.5	75.0	64.0	60.8	41.6	......	E. 2.	0.8.	Thunder.
	3 00	27.290	68.0	68.0	61.5	68.0	68.0	59.0	......	......	SE. 3.	1.0.	
	5 10	27.330	57.0	56.0	54.5	55.0	56.0	58.8	......	......	SW. 2.	1.0.	Rain.
	7 30	27.242	57.5	57.0	54.0	55.0	55.0	59.0	42.6	0.12	SE. 2.	1.0.	Rain.
June 16,	6 00 A. M.	27.228	55.0	54.4	51.5	54.5	54.5	57.5	42.7	......	W.SW. 2.	1.0.	
	8 00	27.256	57.3	57.0	52.5	60.0	57.0	57.6	......	......	W.SW. 2.	0.9.	
	10 00	27.240	63.5	63.5	55.0	81.0	71.0	57.8	43.6	......	S.SW. 3.	0.8.	
	Noon.	27.238	67.0	67.5	57.5	78.0	68.0	59.0	44.0	......	NW. 3.	0.8.	Thunder and rain.
	2 00 P. M.	27.220	62.0	62.0	57.0	66.0	64.0	59.0	......	......	W.SW. 1.	1.0.	Thunder and rain.
	4 10	27.234	69.8	69.0	57.0	69.0	68.5	59.5	44.5	......	W. 3.	0.5.	Rain and hail.
	6 05	27.242	66.0	66.0	57.5	70.0	69.0	59.8	44.5	......	W. 5.	0.7.	Rain and hail.
	8 00	27.268	60.5	60.0	54.0	59.0	59.0	59.0	......	0.13	SW. 3.	0.9.	Rain.
June 17,	5 35 A. M.	27.404	53.0	52.8	49.5	50.5	50.0	57.5	44.0	......	W. 2.	1.0.	
	7 30	27.402	53.5	53.0	50.0	54.0	52.0	57.5	44.0	......	SW. 3.	1.0.	
	9 35	27.396	66.0	67.5	56.5	90.0	70.0	59.0	43.8	......	SW. 2.	0.5.	
	11 05	27.424	71.0	72.0	58.5	93.5	73.5	60.0	......	......	SW. 3.	0.3.	Hazy.
	1 00 P. M.	27.442	71.0	71.0	59.0	84.0	72.0	60.0	43.7	......	SW. 3.	0.5.	
	3 20	27.420	74.5	77.0	60.0	84.0	76 0	61.0	......	......	SW. 3.	0.5.	
	5 00	27.412	75.0	77.3	61.5	79.0	75.0	60.5	43.6	......	S.SW. 1.	0.4.	
	7 00	27.392	68.0	71.0	62.0	70 0	68.0	60.0	43.5	......	Calm.	0.1.	Hazy.
	10 05	27.378	59.5	58.0	55.5	......	58.0	......	......	......	SE. 1.	Clear.	
June 18,	6 00 A. M.	27.286	53.5	57.5	53.5	75.0	56.0	59.0	42.6	......	Calm.	0.2.	
	8 10	27.276	65.8	66.0	60.5	116.0	79.0	60.5	......	......	Calm.	0.2.	Hazy.
	10 10	27.274	75.8	77.8	64.5	81.0	78.0	61.5	43.4	......	Calm.	0.2.	
	Noon.	27.246	80.0	81.5	65.5	81.0	79.5	61.8	42.3	......	E. 1.	0.3.	

Meteorological observations—Continued.

FORT BENTON.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Water.	Gauge.	Rain.	Wind.	Clouds.	Remarks.
1860.	h. m.		°	°	°	°	°	°	In.				
June 18,	2 10 P. M.	27.194	81.5	81.0	64.5	85.0	82.0	62.0	......	......	W.SW. 3.	0.4.	
	4 50	27.168	76.5	76 0	61.0	78.0	76.0	62.0	41.9	......	W.SW. 4.	0.3.	
	6 10	27.164	70 8	70.5	61.5	71.0	70.0	61.8	41.7	......	W.SW. 1.	0.9.	
	8 00	27.130	66.5	66.0	57.5	67.0	65.5	61.5	......	......	S. 1.	1.0.	
June 19,	5 35 A. M.	27.158	53.0	55.0	49.5	66 0	61.0	59.5	40.8	......	Calm.	0.1.	
	7 20	27.182	63.0	62.0	55.0	106.0	70.0	60.0	40.7	......	SW. 1.	0.1.	
	9 15	27.160	69 0	68.0	56.5	71.0	69.5	60 5	40.3	......	S.SW. 3.	0.8.	
	11 00	27.166	68.5	68.8	54.0	69.5	68.0	60.8	......	......	W. 3.	1.0.	
	1 00 P. M.	27.176	73.5	74.0	58.0	73.0	76.5	61.0	40.1	......	W.SW. 3.	0.7.	
	3 00	27.144	75.0	74 5	57.5	78.0	75.0	61.0	39.7	......	W.SW. 3.	0.6.	
	5 10	27.198	71.8	71.5	56.0	72.0	71.0	60.0	39.4	......	W.SW. 3.	1.0.	
	7 05	27.130	64.5	63.5	53.5	65.0	63.5	59.5	39.1	......	SE. 1.	1.0.	
	9 15	27.196	58.6	58.8	52.5	59.5	58.5	59.0	......	......	SE. 1.	1.0.	
June 20,	5 35 A. M.	27.044	51.5	52.5	50.5	68.0	60.0	58.5	37.8	......	Calm.	0.2.	
	7 00	27.054	60.8	60.0	53.5	91.5	69.5	58.8	.....	......	E. 1.	0.1.	
	9 00	27.016	72.5	72.5	60.5	103.5	79.5	60.5	37.3	......	E. 1.	0.1.	
	11 00	26.994	82.0	97.0	64.5	90.0	85.0	62.0	......	......	Calm.	0.1.	
	1 00 P. M.	26.928	84.5	92.0	61.0	96.0	84.0	63.0	36.5	......	S. 2.	0.2.	
	3 00	26.908	85.0	96.0	68.0	94.8	86.0	62.8	36.1	......	W.SW. 1.	0.9.	
	5 00	26.904	82.0	82.8	64.5	82.0	79.0	61.0	35.7	......	W.SW. 1.	0.9.	
	7 00	26.986	63.0	62.5	53.0	62.0	61.0	59.8	34.9	......	W. 8.	1.0.	Storm.
	8 45	27.056	56.7	56.3	50.5	57.5	56.0	60.3	34.6	......	NW. 6.	0.6.	Rain.
June 21,	7 15 A. M.	27.235	46.8	46.5	45 8	47.5	46.3	58.0	32.5	0.14	W. 4.	1.0.	
	9 10	27.256	49.0	46.0	46.0	48.8	46.0	57.0	32.1	......	S.SW. 4.	1.0.	
	11 00	27.276	57.0	58.0	51.5	72.0	57.0	61.5	31.8	......	S.SW. 3.	0.5.	
	1 00 P. M.	27.284	55.8	56.0	50.5	63.0	60.0	59 0	31.3	......	W. 3.	0 9.	
	3 00	27.296	64.5	65.5	52.5	68.0	62 0	60 0	30.9	......	W. 3.	1.0.	
	5 00	27.336	60.0	60.0	49.5	61.0	57 0	59.0	30.5	......	W.NW. 4.	1.0.	
	7 25	27.356	59.5	60.0	52.0	55.5	55.0	58.0	30 0	......	Calm.	0.1.	
	9 50	27.348	47.0	47.0	43.0	42 5	46.0	58.5	29.7	......	Calm.	Clear.	Dew ; comet visible.
June 22,	4 15 A. M.	27.522	39.7	39 7	38.7	38.5	40.0	57.3	28.6	......	W. 2.	0.7.	
	6 00	27.532	42.8	42.5	41.0	56.0	48.0	57.0	28.6	......	W.SW. 2.	0.2.	
	8 00	27.535	56.3	56.5	51.5	92.0	75.3	58.5	28.3	......	Calm.	Clear.	
	10 15 "	27.524	62.0	66.0	56.5	102.0	78.0	59.7	28.1	......	W. 1.	0.9.	
	Noon.	27.521	64.7	65.3	54.9	74.5	66.0	60.0	27.8	......	W. 2.	0.9.	
	2 15 P. M.	27.506	69.5	71.2	57.0	88.0	80.5	60.5	27.4	......	W. 3.	0.8.	
	5 30	27.494	68.0	69.9	56.3	77.5	71.5	60.6	27.2	......	NW. 2.	0.4.	

	7 1[illegible]	27.4[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	NW. 2.	0.1.
	9 [illegible]	27.470	51.0	50.5	47.5	45.0	45.0	57.0	......	......	S.SW. 2.	Clear.
	11 00	27.458	47.0	47.0	......	41.7	......	.....	26.3	......	S.SW. 1.	Clear.
June 23,	5 11 A. M.	27.392	40.8	40.5	40.0	41.0	41.0	56.0	......	......	W. 1.	0.5.
	7 00	27.370	53.0	53.0	50.5	98 0	73.0	59 0	25.4	......	S.SW. 1.	0.1.
	9 00	27.370	65 0	66.0	57.5	104.5	77.0	60.3	25.2	......	NE. 1.	0.1.
	11 00	27.358	73.0	75.8	61.5	96 5	72.5	66.0	24.9	......	E. 1.	0.1.
	1 30 P. M.	27.350	70.5	70.0	56.5	89 0	70.0	64.0	24.4	......	W.NW. 2.	0.6.
	3 00	27.348	70.8	70.5	56.0	75 5	68.5	63.0	24.3	......	W.NW. 2.	0 3.
	5 05	27.352	69.5	68.5	56.5	82.0	70.0	63.5	24 2	......	N. 2.	0.2.
	7 20	27.372	66.0	65.5	54.5	66.5	66.0	59.0	23 9	......	E NE. 2.	0.4.	Rain.
June 24,	6 50 A. M.	27.560	50.0	50.0	48.5	50.0	50 0	56.0	23.3	0.18	SW. 1.	1.0.	Rain.
	8 05	27.578	53.0	53.5	50.0	53.0	48.0	57 0	23.2	......	W. 1.	1.0.
	10 25	27.588	61.5	64.0	57.0	89.0	64.5	62.0	......	......	S.SW. 1.	0.8.
	0 21 P. M.	27.600	68.0	71.0	60.0	96.0	74.0	63.0	22.8	......	S.SW. 1.	0.7.
	2 05	27.562	67.0	69.0	54.0	85.5	66.5	61 0	......	......	E. 1.	1.0.
	4 15	27.596	68.0	70.0	57.5	80.0	76.0	61.0	22.5	......	E.SE. 1.	0.7.
	6 05	27.536	62.8	62.8	53.5	63.8	61.0	59.0	22.4	......	S. 1.	0.5.
	8 00	27.528	56.5	56.0	51.0	54.0	53.0	57.0	22.2	......	S 1.	0.1.
	11 05	27.528	50.8	50.0	47.5	47.5	......	......	......	......	Calm.	0.1.
June 25,	6 36 A. M.	27.529	54.7	59.6	53.0	56 0	54.5	57.0	21.2	......	Calm.	Clear.
	8 05	27.548	63.0	66 0	58.5	81 0	64.0	58.5	21.1	......	Calm.	Clear.
	10 00	27.550	70.0	72.0	59 0	87.5	70.5	62.0	20.9	......	SW. 1.	Clear.
	0 10 P. M.	27.542	73.0	74.5	62.0	89.0	73.0	63.0	20.7	......	SW. 1.	Clear.
	2 00	27.500	78.0	80.0	62.5	103.0	80.0	63.0	20.6	......	SW. 1.	Clear.
	4 00	27.462	75.[illegible]	75.8	61.5	90.5	75.0	63.5	20.4	......	S. 1.	0.1.
	6 05	27.410	72.9	71.0	57.0	80.0	72.0	62.0	20.1	......	E SE. 2.	0 1.
	8 00	27.378	66.0	66.5	54.5	67.5	66.0	59.0	19.8	......	E.SE. 3.	0.1.	Horizon overcast.
	11 20	27.352	63.5	62 0	52.0	......	62.0	58.0	......	......	E 2.	Clear.
June 26,	1 00 A. M.	27.396	55.5	54.0	50.3	......	52.7	57.7	19.3	......	NE. 2.	Clear.	Northern light.
	6 00	27 276	56.8	59.0	55.0	63.0	60.0	57.0	18 6	......	Calm.	0.1.
	8 00	27.290	71.0	75.0	63.5	100 0	82.5	60.0	18.5	......	Calm.	Clear.
	10 25	27.282	84.5	85.0	66.0	92.5	83.0	63.0	18.3	......	S. 1.	Clear.
	0 15 P. M.	27.250	86.0	86.0	66 5	94.0	84.0	66.0	......	......	W. SW. 2.	0.1.
	2 00	27.228	83.5	83.0	63.0	85.0	81.0	66.0	17.9	......	W SW. 2.	0.8.
	4 00	27.156	85.0	86.0	66.5	110 5	87.0	65.0	17.6	......	Calm.	0.1.
	6 00	27.136	72.5	72.0	62.0	74.0	73.0	62.5	17.2	......	E. 1.	0.6.	Thunder ; a few drops of rain.
	8 00	27.128	68.8	68.8	61.5	67.5	62 0	62.0	......	......	E. 1.	0.4.
June 27,	5 00 A. M.	27.252	55.5	55.3	52.5	55.5	55.0	59.0	16.2	......	W NW. 3.	0.8.
	7 00	27 270	55.0	54.5	51.5	56.0	54.3	59.0	16.0	......	W.NW. 2.	1.0.
	9 00	27.308	61.0	60.5	53.5	64.0	60.0	60.0	15.8	......	W.NW. 3.	0.9.
	11 00	27.336	70.8	71.5	59.0	84.5	64.5	64.0	15.7	......	NW. 2.	0.5.
	1 10 P. M.	27.358	73.5	74.0	64.5	77.0	72.5	66.0	.....	......	W.NW. 3.	0.4.
	3 00	27.340	71 8	72.0	60.0	80.0	76.5	66.0	15.7	......	....	0.3.
	5 10	27.320	68.0	68.5	58.0	74.0	74.0	65.0	......	......	W. 2.	0.2.
	7 00	27.340	64.5	64.5	54.5	66 0	64.0	62.0	15.4	......	N. 1.	0.4.
	10 00	27 366	57.8	57.0	49.5	55.5	54.8	59.5	15.2	......	NE. 1.	0.1.
	11 15	27 366	56.0	55 8	51.0	52.0	......	.....	......	......	NE. 1.	0.2.
June 28,	5 45 A. M.	27.398	52.0	52.8	49 5	52.5	52.0	58.0	14 8	0.005	NE. 1.	1.0.	Rainy.
	7 00	27.400	52 8	52.8	49 0	53.8	52.0	58.5	......	......	E. 1.	1.0.
	9 00	27.406	57.0	57.0	51.0	61.0	57.0	59.0	14.8	......	E. 1.	1.0.
	11 05	27.410	60.0	60.0	54.0	69.0	61.0	61.0	14.9	......	N.NE. 1.	1.0.
	1 10 P. M.	27.398	61.5	62.0	54.0	68.0	61.0	61.5	......	......	N.NE. 1.	1.0.

Meteorological observations—Continued.

FORT BENTON.

Date.		Barometer.	Attached.	Dry.	Wet.	Black.	Naked.	Water.	Gauge.	Rain.	Wind.	Clouds.	Remarks.
1860.	h. m.		°	°	°	°	°	°	°	In.			
June 28,	4 05 P. M.	27.374	60.5	60.3	53.5	62.5	60.5	62.0	15.0	......	N.NE. 2.	1.0.	
	6 00	27.354	59.3	58.5	52.5	60.0	58.5	60.0	15.0	......	E. 2.	1.0.	
	8 00	27.383	58.8	58.5	53.0	58.0	58.0	59.0	....	......	E. 2.	1.0.	
June 29,	5 25 A. M.	27.306	53.0	53.0	48.5	53.5	52.5	57.0	14.5	......	NE. 1.	1.0.	
	7 00	27.322	53.5	53.5	49.5	55.0	53.0	56.5	......	......	N.NE. 1.	1.0.	
	9 00	27.328	58.0	59.0	53.5	70.0	59.0	58.0	......	......	N.NE. 1.	1.0.	
	11 00	27.336	67.0	70.0	61.5	95.4	70.5	62.5	......	......	N.NE. 1.	0.6.	
	1 00 P. M.	27.314	71.0	72.3	62.0	90.0	72.0	65.5	......	......	W. 1.	1.0.	
	4 10	27.300	77.0	81.5	65.0	108.0	77.0	67.0	14.3	......	Calm.	0.5.	
	6 00	27.290	67.0	67.5	58.0	73.5	67.0	66.0	....	......	S.SE. 1.	1.0.	
	8 00	27.266	61.5	61.0	53.5	59.0	59.0	63.5	14.2	......	E. 1.	1.0.	
June 30,	5 15 A. M.	27.220	49.5	49.5	47.5	49.0	49.0	57.0	13.7	......	S. 1.	0.2.	
	7 00	27.210	61.0	62.0	58.0	80.0	59.0	58.5	13.7	......	S.SE. 1.	0.5.	
	9 00	27.250	77.8	74.0	63.0	102.0	78.5	66.5	13.7	......	S.SE. 1.	0.3.	
	11 00	27.252	81.3	93.8	66.0	120.0	87.0	68.0	13.6	......	S.SE. 1.	0.2.	
	1 00 P. M.	27.236	81.3	93.0	63.0	97.0	87.0	68.0	13.6	......	E.SE. 1.	0.2.	
	3 00	27.196	76.5	77.0	64.0	81.5	71.8	67.0	13.5	......	E.SE. 1.	1.0.	
	5 00	27.202	74.0	75.0	63.5	77.0	75.0	65.5	13.5	......	W.SW. 3.	1.0.	
	7 00	27.206	73.0	74.0	62.5	72.8	72.5	64.5	......	......	S. 1.	0.8.	
	9 00	27.162	64.5	64.0	56.0	60.5	60.0	61.5	13.4	......	W.SW. 1.	0.4.	From 11h. to 12h. northern light.
July 1,	5 45 A. M.	27.192	55.0	55.0	53.5	60.0	55.5	59.0	13.2	......	N.NE. 1.	0.3.	
	7 00	27.198	63.5	64.0	58.0	80.0	60.0	61.5	13.3	......	Calm.	0.2.	
	9 05	27.228	81.0	77.8	65.0	110.5	94.5	67.5	13.4	......	NE. 1.	0.1.	
	11 00	27.234	86.8	87.5	66.0	101.5	85.5	70.0	13.5	......	W.SW. 2.	0.1.	
	1 00 P. M.	27.214	88.3	90.0	66.5	99.0	87.0	72.0	13.6	......	W.SW. 1.	0.2.	
	3 35	27.182	85.0	87.0	65.0	98.0	95.0	70.0	13.7	......	W.SW. 1.	0.8.	
	5 00	27.156	84.0	86.0	66.0	98.0	88.0	70.0	13.7	......	W.SW. 1.	1.0.	
	7 00	28.128	76.5	77.0	64.5	76.5	76.0	65.5	13.6	......	S. 1.	1.0.	
	8 15	27.120	70.0	69.0	58.5	68.5	68.0	63.0	13.6	......	S. 2.	1.0.	Thunder.
	11 10	27.096	58.0	58.0	53.5	53.0	53.0	......	......	......	NW. 1.	0.1.	
July 2,	0 20 A. M.	27.092	57.2	57.0	53.5	54.0	54.0	64.3	13.6	......	SW. 1.	0.1.	Northern light.
	5 45	27.084	56.5	56.5	51.5	58.0	57.0	60.8	13.4	......	S.SW. 1.	0.2.	
	7 00	27.086	64.8	64.5	59.5	81.0	65.5	63.0	......	......	S.SW. 1.	0.2.	
	9 00	27.098	79.5	79.0	63.5	91.0	77.6	67.0	13.5	......	W. 2.	0.4.	
	11 00	27.110	83.0	83.0	67.5	99.0	82.0	70.0	......	......	W. 2.	0.4.	
	1 00 P. M.	27.090	88.0	89.5	69.0	116.0	90.0	74.0	13.5	......	W.SW. 3.	0.6.	
	3 00	27.064	83.0	83.5	64.5	91.0	83.0	69.0	......	......	W.SW. 6.	1.0.	Thunder, lightning, and hail.
	5 00	27.060	67.0	66.0	59.0	68.0	68.0	65.0	13.5	0.90	W.SW. 4.	1.0.	Rain.
	7 05	27.088	69.0	69.4	61.0	70.0	70.0	64.0	......	......	S.SW. 2.	1.0.	
	9 00	27.094	64.0	63.5	58.0	64.0	63.5	63.0	......	......	W. 1.	1.0.	

July 3,	5 20 A. M.	27.190	56.8	56.0	59.0	67.5	56.0	60.0	18.7	......	E.NE. 1.	0.9.
	7 00	27.918	66.5	67.0	60.5	76.5	64.5	63.5	......	......	W.SW. 1.	0.3.
	9 00	27.236	77.0	77.0	64.0	91.5	74.0	64.5	......	......	W.SW. 1.	0.1.
	11 00	27.262	84.5	85.0	66.0	105.0	81.0	72 0	12.6	......	SW. 1.	0.2.
	1 30 P. M.	27.273	92.5	90.0	64.5	116.0	91.0	75.0	......	......	W. 2.	0.4.
	5 30	27.246	82.5	86.5	66.5	87.0	83 5	69 5	......	......	W. 1.	0.1.
	8 00	27.218	69.0	68.5	59.0	63.5	63.0	65.0	12.0	......	Calm.	0.1.
July 4,	5 00 A. M.	27.224	52.8	53.0	50.0	......	......	......	11.6	......	N. 1.	0.1.
										0 08	....	....	Rain at 4 p. m.

METEOROLOGICAL OBSERVATIONS.

MISSOURI RIVER.

Fort Benton, Key West	July 5,	4 05 a m.,	11 feet above water, bar.	27.348,	att.	63.0.	Started at 4 35 a. m.
Judith creek, mouth	July 5,	3 15 p m.,	bar.	27.478	att.	87.3.	Thunder and rain, 0.10.
Cow island	July 5,	7 30 p. m.,	do	27.598	do	81.5.	Started at 2 30 a. m.
Foot of Little Rocky mountains	July 6,	7 45 a. m.,	do	27.587	do	73.4.	
14th point above Milk river	July 6,	4 20 p. m.,	do	27.602	do	76.3.	Stormy and rain, 0.20. Started at 2 50 a. m.
Big Bend, Shippewa Bend, } near the Round Butte	July 7,	4 40 a. m.,	do	27 830	do	63.2.	Min. 58.5.
	July 7,	9 00 a m.,	do	27.830	do	65.0.	Storm at 4 p. m. Bar. 27.797, att. 73.3.
Great dry fork of Missouri	July 8	......					Buffalo country.
Mouth of Milk river	July 8,	11 00 a. m.,	do	27.881	do	82.5.	1 30 p. m. bar. 27.855, att. 82°.
Mitchell's creek, 2 miles below	July 8,	8 00 p. m.,	do	27.932	do	76.5.	
Fort Stuart	July 9,	2 00 p. m.,	do	28 061	do	83.8.	Rain during night 0.15.
Fort Union	July 10, 11, 12,	mean	do	28.234	do	71.5.	Storm E. 5—7.
Fort Berthhold	July 13,	Noon	do	28.206	do	89.2.	
Indian village, half way	July 13,	7 20 p. m.,	do	28 208	do	87 0.	
Fort Clarke	July 14,	6 45 a. m.,	do	28.235	do	72.5.	
Cannon Ball river	July 15	......					Rain 0.12.
Fort Pierre	July 16,	7 00 p. m.,	do	28.623	do	77.9.	Compared with bar. 1,313, 28.618, att. 78.1 deg.
Do	July 17,	6 15 a m.,	do	28 553	do	71.8.	Of Captain Raynold's exp. 28.568, att. 72.3 deg.
Wood Yard	July 18,	1 40 p. m.,	do	28.688	do	85.2.	
Fort Lookout	......						Eclipse of the sun.
Fort Randall	July 19,	5 30 a. m.,	do	28 869	do	74 3.	At 6 a. m. Dr. Magruder's bar. 27.520, att. 65.0 deg.
		9 15 a. m.,	do	28.878	do	76.4.	At 7 a. m. adjusted bar. 28.836 15 feet above. Rain 0.12.
Jenktown, 5 miles above James river	July 19,	7 45 p. m.,	do	28.877	do	83.3.	Rain 0.15.
Sioux City	July 20,	6 00 a. m.,	do	28 788	do	89.6.	
Sergeant Bluff	July 21	......					Rain during night 0.15 inch.
Old Fort Calhoun	July 22	......					Rain during night 0.05 inch.
St. Joseph	July 23,	10 00 a. m.,	do	29.390	do	83.7.	
Lexington	July 24,	8 45 a. m.,	do	29 522	do	73.3.	
Jefferson City	July 25,	9 00 a. m.,	do	29.598	do	80.2.	
St. Louis	July 26,	9 00 a. m.,	do	29.753	do	83.9.	
		11 15 a. m.,	do	29 800	do	97.8.	
		2 00 p. m.,	do	29.756	do	98.7.	
Washington City, E. corner, D. C	July 29,	1 00 p. m.,	do	29.940	do	83.8.	

APPENDIX.

1. *Table of longitudes as derived from moon culminations with the longitude of Washington Observatory = 5h. 08m. 11.2s. = 77° 02′ 48″ W.*

Station.	No. of days on—		Longitude west from Washington.	Prob. error.	Long. west from Greenwich in arc.	Latest correction.
	I.	II.				
			h. m. s.	s.	° ′ ″	s.
Walla-Walla, N. F	9	4	2 45 24 ±	1.5	118 23 48	.. ....
Cœur d'Alene Mission	7	9	37 12 ±	1.0	116 20 48	+ 0.1
Sohon's Pass	3	2	34 42 ±	2.5	115 43 18	+ 3.6
Bitter Root	12	11	32 05 ±	1.5	115 04 03	....
Hell Gate	3	5	27 47 ±	1.5	113 59 33	....
Fort Benton	7	6	14 25 ±	1.5	110 39 03	....

2. *Table giving the latitude, longitude, magnetic variation, and the height above the level of the sea of the principal stations and some intermediate points.*

Station.	Latitude.	Longitude.	Mag. var	Height.	Remarks.
	° ′ ″	° ′ ″	° ′	*Feet.*	
Dalles	45 36 39	121 09 30	....	....	
Walla-Walla, O. F	46 03 20	118 59 29	....	....	
Walla-Walla, N. F	46 02 59	118 23 48	20 00	915	Further observ'ns indicate 800 ft.
Dry Creek	46 08 48	118 25 27	....	....	
Touchet	46 17 40	118 21 18	....	....	
Reed Creek	46 22 05	118 11 44	....	....	
Fort Taylor	46 33 10	118 10 03	....	636	
Pelouse, 2d camp	46 47 19	....	....	....	
Tcho-Tcho-u-Seep	47 14 50	....	....	....	
In-Chats-Chan	47 23 52	....	....	2,750	
St. Joseph river	47 21 44	116 42 34	....	2,200	
Cœur d'Aléne Mission	47 32 49	116 20 48	20 54	2,2[illegible]0	
Sohon's Pass	47 27 04	115 43 18	20 37	5,100	
Cantonment Jordan	47 22 00	115 19 48	....	2,990	
Bitter Root	47 18 33	115 04 03	20 45	2,4[illegible]0	
Hell Gate	46 52 13	113 59 33	21 00	3,318	
Mullan's Pass	46 38 38	112 12 27	....	5,980	Taken from observation of 1862.
Fort Benton	47 49 43	110 39 03	29 24	2,614	

Table giving the error of the sidereal chronometer No. 525 *at the time of the Moon's transit.*

Station, Astr., and date.		Chron. error. FAST. h.	m.	s.
Walla-Walla—1859, June	6	3	02	38.65
	7			38.76
	8			38.45
	10			38.05
	11			38.75
	12			40.46
	13			42.41
	15			45.10
	16			47 31
	17			46.77
Cœur d'Aléne—1859, August	4	2	56	50.80
	7			55.57
	8			58.38
	9		57	00.20
	11			04.69
	12			06 06
	13			09.03
	14			11.00
	15			12.81
	16			14.96
	17			17.35
	18			19.74
	19			22.35
	20			25.11
Sept.	8		58	19.96
	9			26.41
Cœur d'Aléne—1859, Sept.	11	2	58	30.69
	12			33.46
Sohon's Pass—1859, October	9		56	49.23
	10			47.05
	12			43.94
	13			43.27
	30		57	00.58
Bitter Root—1859, Nov.	6	2	55	42.01
	7			40.69
	8			39.37
	9			35 37
	10			28.01
	11			23.87
	12			24.24
	27			58.04
Dec.	1		56	05.90
	31		58	11.11
1860, January	5			50 30
	6			58.92
	28	3	01	14.03
	29			17.21
	30			22.95
	31			30.40
February	1			37.03
	5		02	10.55
Bitter Root—1860, February	6	3	02	21.40
March	7		06	12.30
	8			25.85
	9			35.03
	10			43.50
	11			54.61
Hell Gate—1860, April	1			10.65
	5			47.17
	7		07	04.00
	8			14.08
	10			37.51
	11			47.34
	21		09	48.11
May	2		11	16.09
Fort Benton—1860, May	25	3	03	23.70
	27			47.81
	28			59.94
	29		04	11.50
	31			35.00
June	3		05	10.98
	4			21.58
	6			49.32
	7		06	01.59
	9			29.35
	20		08	35.73

Data collected during solar eclipse, 1860, *July* 18, *a. m., on steamer Key West, on the Missouri river.*

Lat. ; long. ; error of chron. ; rate .

Time. Chron. 8544. h.	m.	s.	Black bulb. °	Naked bulb. °	Air, shade. °	Wind, force.	Clouds, quantity.	Eclipse, quant'y.	Remarks.
11	00		80.3	78.0	79.0	NE. 2.	....	....	Reg. temps.
	10		80 3	81.5	....	N. 2.	....	....	
			79.0	78.0	....	....	....	....	
	15		....	....	....	....	....	0.0	
	20		83.5	79.0	....	N. 1.	....	....	
	30		85.3	79.7	....	Variable.	....	....	
	40		77.8	75.3	....	SE. 2.	....	....	
	50		80.0	77.0	....	....	Cum str. 0.2	....	
	55		....	....	....	....	....	....	Passed Fort Lookout with a speed of 10 miles an hour.
	58		....	....	....	....	....	0.5	
12	00		79.0	77.5	....	....	....	....	
	05		76.7	74.5	....	....	....	....	Sun entering clouds.
	11		76.0	74.8	....	....	....	....	
	13		....	....	....	....	....	0.6	
	18		....	....	....	....	....	0.7	Max. eclipse.
	20		75.3	74.7	....	....	....	....	
	24	30	75 3	74.7	....	....	....	....	Sun disappears in clouds.
	30		75.2	75.0	75.0	....	....	....	
	33		....	....	....	....	....	....	Sun comes out of strata clouds.
	35		74.8	74.5	....	....	....	....	
	40		75.7	75.4	....	S. 2.	....	....	
	50		79.0	78.8	....	....	....	....	
	55		80.7	77.5	....	....	....	....	
	59	57.0	....	....	....	....	....	0.0	
1	00		78.7	78.8	....	....	....	....	Overclouded again.

J. WIESSNER, *Astronomer.*

TRANSITS.

Cœur d'Aléne Mission, 1859, *September* 11, *at 23h. 13m. sidereal time; chronometer fast 2h. 58m. 31s.*14±; *latitude* 47° 32′ 49″; *longitude 2h. 37m. 12s. west of Washington.*

[An example worked from field observations taken en route.]

Object observed and quantities for reduction, lamp level, &c.	Observed wire.	Obs'ved time. Eggert & Son, 525.			Interval correction	Computed mean.	Δ	Reduction.				
		h.	m.	s.	s.	s.	s.		h.	m.	s.	s.
a Ursæ Majoris, L. C., lamp east	1	1	50		....	....	....	Mean wire	1	53	32.35	± 0.07
D = 62° 30′ Z = 75° 03′	2		51	01.0	+ 151.5	32.5	− 0.2	r = − 0′.15, r t =			+ 0.05	
Log. sec D = 0.3356 C = − 2.166	3		51	50.0	+ 101.7	31.7	+ 0.6	c = + 4.50, c C =			− 9.74	
Log. cos. Z = 9.4116 9.7472 B = − 0.559	4		52	41.8	+ 50.6	32.4	− 0.1	b = + 0.27, b B =			− 0.15	
Log. sin. Z = 9.9850 0.3206 A = + 2.092	5		53	32.8	− 0.4	32.4	− 0.1	a = + 4.75, a A =			+ 9.95	
Level $1^d = 1.00''$	6		54	23.0	− 50.8	32.2	+ 0.1	Transit	1	53	32.46	
W. E. Diffs.	7		55	13.5	− 100.6	32.9	− 0.6	Tab. AR.	22	55	01.36	
65 − 59 × = $+6.^d$	8		56	04.0	− 151.6	32.4	− 0.1	Error	2	58	31.10	
× 67 − 57 = + 10. $+ 16^d$	9		56	54.0	− 201.8	32.2	+ 0.1	Tab. corr'n			− 0.04	
φ Aquarii, lamp east	1	2	03	54.3	+ 93.7	+ 94.0	− 0.3	Mean wire	2	05	28.02	± 0.03
D = −6° 48′ Z = 54° 21′	2		04	17.5	+ 70.5	+ 70.5	0.0	r = − 0.15, r t =			+ 0.01	
Log. sec. D = 0.0031 C = + 1.007	3		04	41.0	+ 47.0	+ 47.0	0.0	c = + 4.50, c C =			+ 4.53	
Log. cos. Z = 9.7655 9.7686 B = + 0.587	4		05	04.3	+ 23.7	+ 23.7	0.0	b = + 0.27, b B =			+ 0.15	
Log. sin. Z = 9.9100 9.9131 A = + 0.819	5		05	27.7	+ 0.3	+ 0.2	+ 0.1	a = + 4.75, a A =			+ 3.89	
Level	6		05	51.6	− 23.6	− 23.5	− 0.1	Transit	2	05	36.60	
W. E	7		06	15.5	− 47.5	− 47.5	0.0	Tab. AR.	23	07	05.46	
× 68 − 56 = $+ 12.^d$	8		06	38.3	− 70.3	− 70.5	+ 0.2	Chron. error	2	58	31.14	
63 − 60 × = + 3. $+ 15.^d$	9		07	02.0	− 94.0	− 93.8	− 0.2	Tab. corr'n			0.00	
Moon's I Limb, lamp east	1	2	09	49.0	+ 95.2	+ 95.2	0.0	Mean wire	2	11	24.94	± 0.04
D = − 2° 14′ Z = 49° 47′	2		10	12.8	+ 71.4	+ 71.4	0.0	r = − 0.15, r t = (1.02)			0.00	
Log. sec. D = 0.0003 C = + 1.001	3		10	36.5	+ 47.7	+ 47.6	+ 0.1	c = + 4.50, c C =			+ 4.59	
Log. cos. Z = 9.8100 9.8103 B = + 0.646	4		11	00.5	+ 23.8	+ 23.9	− 0.1	b = + 0.28, b B =			+ 0.22	
Log. sin. Z = 9.8829 9.8832 A = + 0.764	5		11	24.1	+ 0.1	+ 0.2	− 0.1	a = + 4.75, a A =			+ 3.80	
Factor for Moon's motion and parallax 1.020	6		11	48.3	− 24.1	− 23.8	− 0.3	Transit	2	11	32.85	
W. E. 1 + 0.00277m. − sin. w cos. φ sec. δ, Lee's table, p. 231	7		12	12.5	− 48.3	− 48.1	− 0.2	Tab. AR. Cor. for above long. Cor. to tab. at Washington	23 	08 + 4 −	12.27 49.55 0.13	
65. − 59. × = $+ 6.^d$	8		12	35.3	− 71.1	− 71.4	+ 0.3	Chron. error	2	58	31.16	
× 68. − 57. = + 11. $+ 17.^d$	9		12	59.2	− 95.0	− 95.0	0.0	Tab. corr. at station			− 0.02, or corr'n to assumed long. − 0.02 × 32.5 = − 0.65	

κ Piscium, lamp east
D = + 0° 29′   Z = 47° 04′
Log. sec. D = 0.000   C = + 1.000
Log. cos. Z = 9.8333   B = + 0.681
Log. sin. Z = 9.8646   A = + 0.732
Level
W.   E.
× 69. — 57.   = 12.^{d}
67. — 58.   × = 9.   + 21^{d}

2	16 59.8	+ 69.9	9.5	0.0
3	17 23.0	+ 46.6	9.6	— 0.1
4	17 46.0	+ 23.5	9.5	0.0
5	18 09.2	+ 0.2	9.4	+ 0.1
6	18 33.2	— 23.3	9.9	— 0.4
7	18 56.5	— 47.1	9.4	+ 0.1
8	19 19.4	— 69.9	9.5	0.0
9	19 42.4	— 93.0	9.4	+ 0.1

Mean wire			[illegible]
r = — 0.15, r f =			— 0.02
c = + 4.50, c C =			+ 4.50
b = + 0.35, b B =			+ 0.24
a = + 4.75, a A =			+ 3 37
Transit	2	18	17.62
Tab. AR.	23	19	46.48
Chron. error	2	58	31.14
Tab. corr'n			0.00

	m.	s.
NOTE.—The difference in AR. of φ Aquarii and κ Piscium is by the American Ephemeris	12	41.02
Professor Mitchell, Cincinnati		41.05
Observations at Cœur d'Alene Mission		41.02

ERRATA.

Page 11, fourteenth line from bottom, for "Weisner," read "Wiessner."

Page 17, nineteenth line from bottom, for "cramping," read "camping."

Page 127, twelfth line from top, for "In-Chats-Khan," read "In-Chats-Chan."

Page 129, in station column, third line from top, for "Sil-say-pow-vet-sin," read "Sil-sil-cep-pow-vetsin."

Same page and column, nineteenth line from top, for "Lo-choolts," read "Lo-chuls."

Same page and column, twenty-fourth line from top, for "In-chats-khan," read "In-Chats-Chan."

Same page and column, twenty-seventh line from top, for "Pown," read "Poun."

Page 132, in column of heights, twenty-fifth line from top, for "3,819," read "3,849."

Page 133, in column of distances, eighth line from top, for "245.86," read "255.86."

Page 177, first line, for "five," read "four."

Page 178, twenty-fourth line from bottom, for "$[w - e\,\underline{\times}] + [w\,\underline{\times} - e,]$" read "$[w - e \times] + [w \times - e.]$"

Page 179, eighth line from bottom, strike out the words "*or observations with the transit.*"

Page 180, sixth line from top, strike out the comma after the word "time."